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THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LXI.—No. 12. Whole No. 1,006. | NEW YORK, MONDAY, SEPTEMBER 17, 1894. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, N. Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post-office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Twenty-Second Annual Meeting, American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY, PROVIDENCE, R. I., Sept. 8, 1894.

Extract from the Constitution.

Sec. 12. Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least 10 days prior to the meeting at which the application is acted on.

GENERAL ANNOUNCEMENT.

The 22d annual meeting of the American Gas Light Association will be held at Washington, D. C., October 17, 18 and 19, 1894.

The meeting will be called to order by the President, W. H. Pearson, of Toronto, Canada, at 10 o'clock, A.M., on October 17, in Builders' Exchange Hall, on 13th street, between G and H streets. This is 3½ blocks from the headquarters, the Arlington Hotel, which is located on the corner of H street and Vermont avenue, one block from the White House. The Arlington is conveniently reached by the principal street car lines, as are the other first-class hotels in its vicinity.

As the most satisfactory quarters are always obtained by writing in advance to the hotel people, the following list of hotels is appended, and it is particularly suggested that in writing to them a reply be requested, for which a self-addressed and stamped envelope should be inclosed, as misunderstandings and disappointments may thereby be averted. Remember, "First come, first served."

Hotel.	Rate per Day.	Distance from Hall.	Remarks.
Arlington.....	$4 to $5	3½ blocks.	This is headquarters.
Riggs House....	$3 to $5	2 "	Located at 15th and G streets.
Willard's	$3.50 to $4.50	3½ "	Located at 14th street and Penn ave.
Ebbitt House...	$4	2½ "	Located at 14th and F streets.
Wormley's.....	$3	2½ "	Located at 15th and H streets.
Normandie.....	1 in room, $4.50 2 " 3.50 3 " 3.00	4 "	Located at 15th and I streets. Can take 100 persons.
Shoreham.....	$4	2½ "	Located at 15th and H streets. Can take 125 to 150.
Hamilton House	$2.50 up	4 "	Located at 14th and K streets.
National.....	$4	10 "	Located at Penna. av. and 6th st. Cars go within 3 blocks of hall.
Metropolitan....	$2.50	10 "	Penna. ave., close to National Hotel.
Howard House.	$2.50	10 "	Penna. ave., close to National Hotel.

All of the above hotels are conducted on the American plan, and can take from 25 to 50, except the Normandie and Shoreham (see "Remarks," above). The rates named by the Arlington, Riggs, Willard's and Normandie are special for this convention.

Reduced rates for transportation are being arranged for and undoubt-

edly will be secured. The final arrangements will be fully explained in a later circular of detailed information.

The roll call will be made by means of the door card method as usual, and be in charge of one of the Committee of Arrangements. Each member or visitor upon entering the hall for the first time will at the door receive a special card upon which to write his name, address, etc., the card then to be given to the doorkeeper.

The list of papers to be read at the meeting is not given herewith, as some of them are still in question, or titles not definitely settled; but the members are particularly requested to carefully read every page of the July and October "Quarterly," and come to the meeting prepared to discuss the articles therein presented, as the papers will be distributed in that form only. A complete list of the papers will be given later in the circular of detailed information.

Each member is expected to send in not only papers on original subjects, but also written discussions or analyses of any or all of the papers written by others, such written discussions to appear in the next issue of the "Quarterly."

The Question Box will be be made a special department of the "Quarterly," provided the members will support it by sending in responses to queries, as well as to keep the Box full of questions, which will be printed in each issue with the responses to the queries of the previous issue. Send in your questions as early as possible; *now*, if you can.

The Committee of Arrangements are completing the details of their programme, which will be reported later in another circular above referred to. The Secretary, however, is allowed to hint that the members will not be obliged to "kill time" for want of entertainment. The ladies will also be well cared for as usual.

Agreeably to the ancient custom of the Association, it is proposed to hold the traditional banquet on the evening of Thursday, Oct. 18, and in continuation of the precedent established last year, each one will pay for his own ticket. In order that the Committee may have some reliable data upon which to base their arrangements, will you please *immediately* fill out and mail the inclosed card to the Secretary, as this is very important, that the data therein asked for should be in his hands as soon as possible, *whether you expect to attend the meeting or not.* The Committee cannot complete their work without it.

During the days of the meeting bulletin boards will be placed in the lobbies of the Headquarters and the Meeting Hall. All members are warned to take due notice thereof and govern themselves accordingly, that they may be apprised of any change in or addition to the programme.

Many of the members have allowed their dues to remain yet unpaid, and this is a source of much difficulty to the Treasurer and extra work and worriment to the Secretary, who has already sent several statements to each of the delinquent ones, as you must know, if you are one of them, unless you have failed to notify him of change of address.

The present addresses of the following-named members are unknown to the Secretary, who will be glad to receive any information concerning them: Joseph L. Hallett, E. H. B. Twining, Ed. R. Conant, Robert N. Sumner, W. I Wilson.

Don't forget that postal card to return. A. B. Slater, Jr., Sec.

Extract from the Constitution.

51. No member who owes two years' dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the Proceedings.

52. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Council.

BRIEFLY TOLD.

The Washington Meeting of the American Association.—We presume our readers have pretty thoroughly digested the official announcement, made by Secretary Slater respecting the coming meeting of the American Gas Light Association, which will be called to order in Washington, D. C., just a month from to-day. The announcement (which appears in our current number) shows that the officers of the Association have been up and doing in the matter of arranging the preliminaries; not only so, but that they have done well. Washington, in mid-October, is a most attractive city to visit, and with its many charms to tempt the traveller, we venture to assert that the attendance at the American Association's 22d annual convention will be rather above than under the average. Perhaps an above-the-average attendance would be especially appropriate this year, since the assemblage is to be presided over by a gas man whose first allegiance is to Great Britain, in respect of country, albeit his home and business ties have for years been only across the border of the Empire State. Still, Canada and the States in most matters are one; and certainly community of interest in the gas business has never had a fairer or stauncher representative than in the person of Mr. W. H. Pearson, of Toronto, Canada. His record is easily traced, and the results achieved by him in the gas makers' craft require no laudation on our part, or the part of anyone else; for the Consumers Gas Company, of Toronto, stands out as a corporation which has faithfully served its proprietors without attempting to pinch its patrons. So we all hope that the American will turn out in full force, and the evidences of the present all point that way. No one can excuse himself on the ground that his pockets are too light or that the securing of accommodations is difficult, since the Secretary's list of suitable hotels shows rates to suit all purposes and rooms without number. The headquarters selected are admirable on every score, and the meeting room in Builders' Exchange could not be improved upon. In 1884 the Association held its Twelfth Meeting, in Washington, on which occasion the headquarters and meeting room were in Willard's Hotel, and many will remember, no doubt, how smoothly and successfully the sessions were brought off; but changes come with the moving decades, and it is doubtful now whether Willard's would be up to the increased demands of the Association. The technical portion of the programme promises well, and we already have before us two of the papers that are to be discussed, the same having appeared in the issue of the Association's *Quarterly*, bearing date of last July. One of these, written by Mr. Frederic Egner, of Norfolk, Va., is a recapitulation of his observations on sundry methods of making water gas from bituminous coal, and to say that it is interesting is to award it mild praise indeed. The second is from the pen of Mr. Walton Clark, of Philadelphia (Vice-President of the Association), who has prepared a very complete analysis of the subject of the public ownership of gas properties. The *Quarterly* for October will contain the other fixed numbers on the paper list, and the members ought to pay due heed to the Secretary's admonition that the July and October issues of the *Quarterly* should be carefully read in view of the fact that "the papers will be distributed in that form only." As near as may be predicted, there will be no less than six papers for discussion. The Question Box will also be a feature. A very complete entertainment programme is being completed; and it is more than probable that the Secretary—who is certainly living up to every requirement of his burdensome position—will be enabled in due time to announce that he has secured from the railroad companies a substantial concession in the instance of transportation rates.

The State of Trade.—It is with no little satisfaction that we can truthfully report a decided gain in output for the quarter ended August 31st, 1894, as against the corresponding quarter of 1893. Returns from 32 answering test points (out of a total of 50 inquired for) show a grand average gain of 6.8 per cent. Further, the general tenor of the opinions submitted by those who, in replying, commented on the outlook in their respective districts, is undeniably positive that matters are decidedly on the mend. A feature of the quarter's trade has been the attention given to the development of the use of gas for cooking purposes. One Company reports that its investment in this line more than doubled its day sendout in August, 1894, as against the same month a year ago. In fact, its day sendout in August, 1894, was within 22 per cent. of its total sendout for the same month in 1893. And the place is not a very small one either. It is true that very liberal inducements were held out to the consumers, but the proprietors of the Company evidently have nothing to regret on that score, since the final comment of our informant is: "We should have gone into this thing years ago." Take it all in all, an average net gain of 6.8 per cent. for the quarter is an excellent showing. We might also add that of the 32 Companies answering, only 4 reported a loss, the maximum of which was 5.2 per cent.

Death of Mr. Amos C. Barstow.—A paralytic stroke terminated the life of ex-Mayor Amos C. Barstow, of Providence, R. I., on the afternoon of the 5th inst. Deceased, who was President of the Providence Gas Company (he refused a re-election thereto at the 1893 annual meeting, on account of advancing years, although he did consent to remain on the Board of Directors), was born in Providence, April 30, 1813, and on the completion of his education, when in his 20th year, he engaged in mercantile business. His career was one of almost unbroken success, and at the time of his death he was identified with so many corporations in and about Providence that to name them would be quite like printing a business directory of the city. He was prominent in the church, charitable and political affairs of Rhode Island, and throughout his long and active career maintained an unblemished reputation.

Notes.—At the special meeting of the Board of Directors of the Providence Gas Company to perfect organization, the officers chosen were: President, Hon. Royal C. Taft; Vice-President, Col. William Goddard; Treasurer and Secretary, Mr. A. B. Slater.——The electric lighting plant at York, Pa., was recently sold by the sheriff. It was purchased by W. F. Stewart, at his bid of $26,000.——The Municipal Light Board, of Wakefield, Mass., in arranging a schedule of prices for an incandescent electric light service for ordinary consumers, put the rate for each 16-candle power lamp at $1 per month.

Experiences with Some Leaky Gasholder Tanks.

[A paper read by Mr. J. Chadwick, before the Incorporated Gas Institute.]

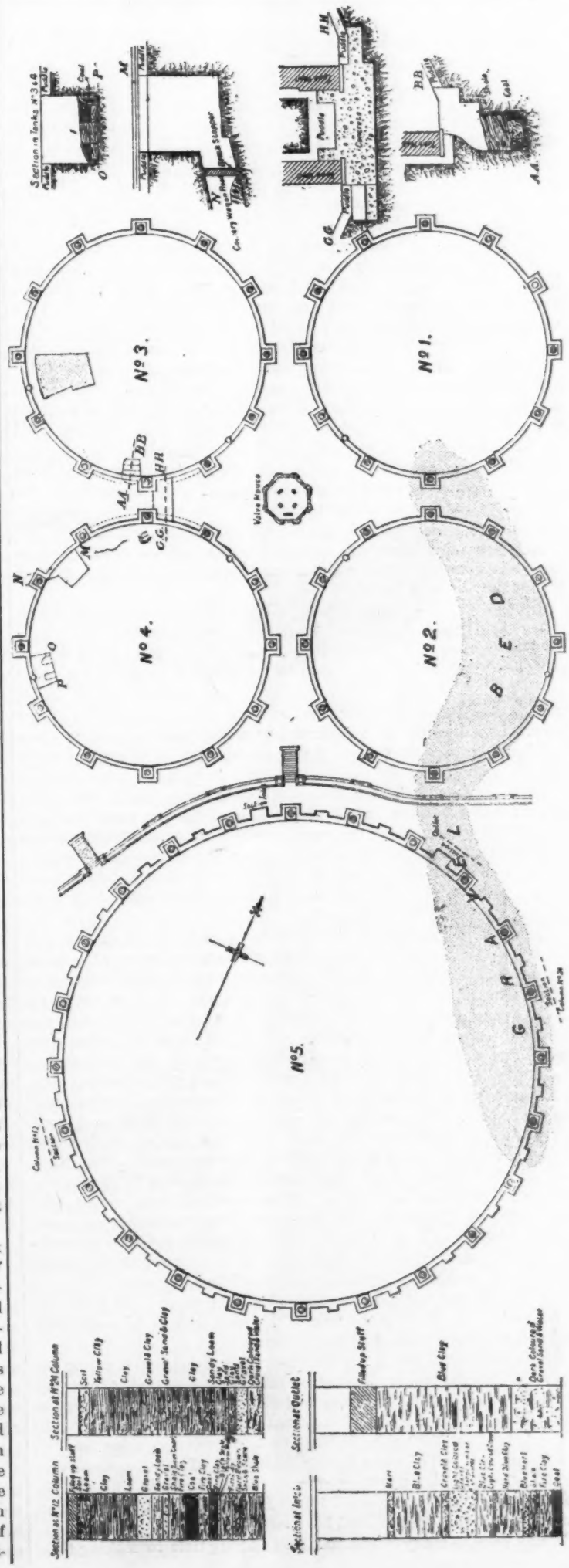
Probably most of us, at some time or other, have had experiences of various sorts. Things do not always move so smoothly as one could wish; difficulties present themselves, and accidents happen, often from unforeseen causes, and entirely beyond our control. Sometimes it may be that cases occur within one's knowledge which may be of advantage or of interest to others, if the circumstances and surroundings were made known.

For a long time, on and off, I have had a considerable amount of trouble with leaky gasholder tanks. Many gentlemen previously to myself have had similar troubles; and possibly many others will yet have to try their hand at repairing leaky gasholder tanks. Difficulties of this character, and means taken to remedy such defects, have been the subjects of papers which have been read before this Institute by gentlemen who have been so fortunate, or unfortunate (as the case may be) as to have had this class of work fall to their lot. I therefore do not claim to bring before you a new subject; but it may be that the reasons for, and the cause of these particular tanks leaking, differ somewhat from others, and so I have ventured to think that my own experiences might not be altogether uninteresting.

I feel that, to enable you to understand what I wish to convey to your minds, I must go back somewhat in the history of these tanks. In the years 1868-70, there were four gasholder tanks constructed at the works to which I refer, in close proximity to each other, as shown on the accompanying diagram, Nos. 1, 2, 3, and 4. The tanks are each 102 feet in diameter and 30 feet deep, built of bricks, with stone footings, ring courses and copings. They are of the kind known as puddled tanks; the walls and bottoms being backed and covered with clay puddle. In the year 1870, gasholders on the telescopic principle (each holder being in two lifts) were erected in the tanks marked No. 1 and No. 2 on the diagram; and in the following year the two gasholders were put into use, and continued to work all right up to the year 1889.

In the year 1879, an additional gasholder, similar to those already mentioned, was erected in the tank marked No. 3 on the diagram; and it was constantly in use from this time up to October, 1884. Another gasholder was erected in the tank marked No. 4 on the diagram, and was completed in the month of October, 1884. When this gasholder was about being completed, the water was turned into the tank, and allowed to run in gradually until it was 26 feet deep, or only 4 feet short of being full. It then showed signs of losing water, which ran slowly away for some days; and eventually No. 3 tank (which had been in constant use for five years) showed signs of losing water also. As soon as the water in No. 3 tank began to lower, it commenced to rise in No. 4 tank; and ultimately both tanks attained the same level. There was therefore not only an absolute leakage, but also a connection between the two tanks. I then fixed a pump in No. 3 tank; and by working it in this position, succeeded in emptying the water from both tanks. Upon examining the tanks, I found a hole in the bottom of No. 3, through the puddle. It was about 4 feet up the slope of the mound, and near to No. 4 tank. The bottom of No. 4 tank was very bad in several places. There was a hole near the outlet pipe, one near No. 3 tank, and several others where the water had apparently run away. It had now got into November; and I was anxious to get one of the holders into working order for the winter months, if possible (which, however, I was unable to do), so after some preliminary preparations, I began the repairs in No. 3 tank, as this seemed to require the least work.

An excavation was made near the hole before mentioned, which took a slanting direction, and was cut through 2 feet of puddle, and about 7 feet of good, hard, stiff clay. The hole was in size and appearance something like a rabbit run. The ground was firm and solid, and seemed good enough to have stood any pressure that was put upon it. The excavations then reached the shale, the coal measures, and the old coal workings. After having found a sound bottom, the excavation was made good with concrete. I may parenthetically observe that some of the middle coal measures crop out in this locality, and that others are found at no great depth below the surface. These mines were worked in this neighborhood many years ago; and I have no doubt in my own mind but that the hole found in the bottom of No. 3 tank was in the first instance started and made by rats, burrowing upwards from the old coal workings. I found that considerable repairs were necessary in No. 4 tank, as there were several places which showed indications of weakness. A considerable portion of the tank wall required underset-



ting; and the rest stones and outlet pipes all wanted taking out and refixing.

Both lifts of the holder were therefore raised about 3 feet, and packed up with timber from the rest stones and center pier. The rest stones were taken out one at a time, the floor made good, and the stones replaced. The ground was excavated all round the interior of the tank wall, and filled in with concrete. This excavation varied in depth from about 5 feet to 11 feet below the footing stones of the tank wall; and in many places the wall had to be underset and filled up with concrete. At point *N*, as indicated on the diagram, the excavation reached 17 feet below the footing stones, and was in an old heading, or wagon road, of the disused coal workings. In some places timber was found which had evidently been used as prop wood by the miners, and pillars of coal which had apparently been left in to support the roof. The coal had evidently been worked out here, and partly filled in with dirt, smudge, and coal rubbish; and in some places the puddle of the tank was placed almost immediately on this material. I endeavored to obtain a hard bottom to start the concrete from, and mostly went down to the fireclay. There was a serious defect under the outlet pipes, which had to be taken out; and here we came upon the old coal workings and wagon road again, with pillars of coal left in, and filled in with old coal rubbish as before. Here, too, we found some of the old prop wood left in by the workmen, probably many years before. There were also several holes in the ground, which I am strongly of opinion had been made by rats. This place was also made good with concrete, and the walls were underset with similar material. The outlet pipes were then refixed. The inlet pipes had only slightly given way, and this was rectified without their removal. On the diagram you will notice two or three sections showing the position and state of the old coal workings, etc., at the points indicated.

After having, as I thought, made all good, No. 3 tank was filled with water during the latter part of April, 1885; and the holder was put to work on the 7th of May following—No. 4 tank having only 2 feet of water in it at this time. On the evening of May 9, however, the water began to run out of No. 3 tank, finding its way into No. 4 tank; and it ran so rapidly that the water was lowering at the rate of 1 foot per hour. I went inside No. 4 tank, and found the water boiling up like a whirlpool through the bottom. I put No. 3 holder out of use as soon as possible, and on the following day the water in both tanks had attained the same level—viz., 13 feet below the coping stone—which was maintained for several days. It therefore appeared that the worst fault previously existing—namely, the running of the water absolutely away—had been remedied. There, however, was still a fault between the two tanks; and it appeared to be at about the point indicated by the water coming into No. 4 from No. 3 tank. I therefore determined to dig down between the two tanks at this point.

The water was pumped out of the tanks again (by fixing the pump in No. 3 tank only), and then an excavation was made between the tanks to a depth of 35 feet. I found the puddle washed away from under both walls, and the ground was full of water, which drained out whilst the excavation was open. The earth and the puddle were broken and disturbed for about 8 feet above the bottom of the tank walls, and it was possible for a person to have crawled from one to the other underneath the bottom of the walls. The walls were underset with concrete entirely through the whole thickness, and a concrete stay was carried across the excavation. The puddle and excavation were then made good. On examining the floors of the tank I did not find anything wrong with No. 4 except just at the point where the water came in from No. 3, and which was remedied by concrete; but the floor of No. 3 tank was very much disturbed and broken. It appeared as if it had settled down somewhat, and I attributed it to the water getting into the loose material and washing part away with it. The tank wall wanted undersetting for some distance, which was done; and the excavations went through the old coal workings, to get to a hard foundation. Several of the rest-stones had slipped and slid from their original position, and these had to be reset. The whole of the floor of this tank had to be re-puddled, and several places made good with concrete.

In the summer of 1885 I had the repairs completed, and began to run the water into the tanks. This was done gradually, and at intervals. It turned out that No. 3 tank was perfectly water-tight, but there was a slight leakage from No. 4, which did not show until the tank got half full. I then put the holder in No. 3 tank to work once more, and left No. 4 tank half full of water during the winter. The leakage was very small; so during the following summer I filled the tank, and put the holder to work in the autumn of 1886. Both tanks and holders have worked continuously since, and have remained tight.

It may seem to many of you that I was a long time in making these repairs, and I am free to admit that this was so. But seeing the nature of the ground, and considering that my holder room at the time was very limited, and in view of the fact of having to underset the walls, which were in close proximity to the tanks which were working, I did not think it wise to have much work in pieces at once; so I proceeded in short sections, and made each good before I commenced another. I was not, therefore, able to put a large staff of workmen on the work. If I had been so unfortunate as to have set the other tanks leaking, both I and my Committee might have become more notorious than we should have cared for.

In the year 1889 it became necessary to construct another tank, and one of 202 feet diameter and 30 feet deep was commenced in close proximity to the others. Before the work had proceeded very far, however, the old trouble came on again; and by the time we had got half way down the sump hole in No. 5 tank, No. 2 tank began to leak. Appearances seemed to indicate the existence of a gravel bed, which extended on the easterly side, and underneath Nos. 1 and 2 tanks, and up into No. 5 tank; and as soon as this gravel bed was cut through into No. 5 tank excavation, No. 2 tank began to leak, and subsequently No. 1 tank also. I had to take a lot of this gravel bed out from under the walls of No. 2 tank on the north and easterly parts, make good with concrete, and stop back the water and sand. I did not empty the water out of No. 1 tank, but did what was possible to that tank from the inside of No. 2 tank. In consequence of the broken nature of the ground, and knowing how close we were to the old coal workings, I covered the floor of this No. 5 tank with a layer of concrete 6 inches thick. It appears to me that this gravel bed (which seems fairly large) is surrounded by clay or other impervious material, which holds the water in it; for Nos. 1 and 2 tanks were tight until we cut through it in the excavations.

In 1891 the gasholder in No. 5 tank was put to work, and all of them have continued working since. I cannot say that the whole of the tanks are absolutely water-tight. There is a slight leakage from No. 5 tank, which I think finds its way into No. 2 tank; but with this exception they seem all right. There has been no increase in this leakage during the three years it has been working—if anything, it is rather less. The level of No. 5 tank is 12 feet higher than that of the other tanks.

The ground in this locality is of a somewhat broken character, as may be noticed from the two geological sections taken in No. 5 tank excavations. As I previously said, some of the middle coal measures crop out in this neighborhood—in fact, on our own land I have found them within 4 feet of the surface—whilst at a short distance away to the northeast the lower coal measures come to the surface. There are also numerous faults in the strata in this district. Within 200 yards of the spot referred to, some 8 or 10 years ago there was exposed to view in close proximity to the original surface of the ground the remains of a veritable fossil forest, with numerous tree trunks of considerable size on every hand. This was a unique sight, and brought a good number of persons from various parts of the kingdom to see it, including many gentlemen of high scientific attainments.

I need scarcely say to a meeting of this character how necessary it is for great care to be exercised in selecting suitable sites for works of this description. If good, hard and stable ground can be got, well and good; but if not, and we have to put up with a site of a somewhat questionable nature, it is desirable to counteract as far as possible any faults in the ground, by works of a suitable constructive character, even if the expense should be more than one anticipates. Gentlemen who have had experiences of repairing gasholder tanks will, I think, agree with me that it is a disagreeable, nasty, awkward, sometimes dangerous and always expensive piece of work.

Discussion.

Mr. W. R. Chester (Nottingham) said the subject of leaky gasholder tanks was one of almost perpetually recurring interest to gas managers; and the difficulties referred to in the paper were almost sure to crop up at some time or other. Mr. Chadwick was to be congratulated on the successful manner in which he had dealt with the subject; and his experience would be of service to those who might hereafter be troubled in a similar way. During the past two years, he (Mr. Chester) had had considerable trouble with leaky tanks which were formerly perfectly tight, but, in consequence of taking the water out of them for the purpose of enlarging the holders by doubling the lifts, they became leaky, and continued so for some time. The structure of the tanks was substantial, and the bottom surface was covered entirely with 2 feet of puddle. The height when full was 10 or 12 feet above the natural water level of the ground. When they commenced pumping the water from the tanks,

having no plans to show the formation of the ground, they began to take it from the inside, and got down to the natural water level without much difficulty. Then they had to put on another pump, and they went a little lower. Subsequently, they had to add another pump, until the water mastered them altogether, and it was not until they made an excavation on the outside, by sinking a sump hole and putting in two 15-inch pumps, that they succeeded in mastering the water. Then they found that over the whole surface of the tank there were springs issuing from the sandstone below in considerable volume; and though in the sump hole they were 10 feet below the level, the springs continued boiling up for some weeks, and it appeared as if they were unable to master them until they had drained the whole area within a considerable distance. When they were mastered, and the gasholder repairs effected, and they came to put in the water, they found that, as fast as they did so, it ran out again by the holes made by the springs. These springs, in percolating through the puddle, had carried with the water a certain amount of sand, which had been deposited, and formed a sort of core through which the water was able to leak out as fast as it formerly leaked in. They overcame this difficulty by maintaining the water sufficiently low for some time, and by digging over the whole of the puddle, and making every part of it good; but he was sorry to say that, when they came to put the water in again, after reaching the top within a few feet, a tremendous leak began to develop itself. They were very anxious to get the holder into work, and so they took a pole with a foot on the end of it, weighted to about 256 pounds, and began going over the whole surface, until one day they happened to hit upon the exact spot where the leak was. Having put a little additional puddle there, and rammed it in, the leak was effectually stopped. If they had been successful in getting on to this spot on the first day, no doubt they would have been able to stop the leak then. This only showed what an amount of patience and care they had to exercise in endeavoring to ascertain where a leak was, as they were working almost entirely blindfold; but when the leak was discovered, a very simple thing was generally sufficient to rectify the defect.

The President remarked that it would probably be difficult to find a case exactly like Mr. Chadwick's; but if any of the members did happen to come across such a case, they would know how to deal with it.

Mr. George Anderson (London) said he desired to thank Mr. Chadwick for putting this matter before the meeting, and to congratulate him on having overcome the excessive difficulties he had described. He must have felt great chagrin at all these things for which he was in no way answerable. They were all accidents for which nobody could be blamed. If any gentleman had a leaky tank, he thought he could not do better than send for Mr. Chadwick, who had had such varied and extraordinary experience that almost anything that would occur to anyone would occur to him.

Mr. E. C. Riley (Swindon) stated that he had a tank close to the side of a tidal creek, and the bottom of the excavation for it was near the low tide level. After part of the foundation had been put in, they found on one side that instead of the rock which for three parts of the circumference formed a foundation, there was a hole about 14 feet deep, full of quicksand, which, being almost on the tide level, they found rather difficult to deal with. However, they removed it, and gradually filled in with concrete between the tides, until they obtained what he believed to be a really firm foundation. The tank was completed, and gradually filled with water; but, after reaching the level of the overflow, the second day, they found the water was falling. Shortly afterwards it went down 4 or 5 feet, and then again to 6 or 7 feet. They thereupon emptied the tank, and discovered that it was cracked down one side from the top to the base, which meant stripping the outside. They found one portion of the foundation that had been put upon the concrete, which they believed to be made good, had not been as solid as it should have been, and the part resting on the rock being absolutely firm, there was a slight settlement sufficient to crack the tank right down. They examined the concrete, and on the top, after cleaning away, they laid lead plates ¼ inch thick in the opening under the brickwork, and built in with bricks imbedded in tar, made good behind with puddle and concrete, and filled up again. The tank was now full to within 4 feet of the top. But they had not ventured to go any farther, as they found a very slight leakage; and they were leaving it at present in the hope that better things would follow after the work had had time to consolidate. He was trying to ascertain what was the lesson to be drawn from Mr. Chadwick's experience, with which he heartily sympathized. Did he consider the moral should be that, in making the foundation, in cases where the ground was at all doubtful, they should go to a greater depth than was usually considered necessary, in order to satisfy themselves of its nature and provide against such contingencies? Mr. Chadwick did not say what his experiences were with a foundation when the tank was originally excavated—whether there were any indications of faults when the ground was first dug out. With all the difficulties Mr. Chadwick had had, he (Mr. Riley) should have almost expected to hear of some indications of them being discovered at the bottom during the excavation for the foundation.

Mr. H. Ashton Hill (Wallasey) said the last speaker had touched upon what was passing through his own mind—the moral to be derived from this story. It was interesting to have explanations of difficulties and means of overcoming them, and he thought the moral was to be sure to have a proper foundation. In this connection he would suggest that the study of geology was a very useful one for engineers. If possible, they should take into account the geological characteristics of the neighborhood where they were working; and even with this knowledge, it was generably advisable to put down trial holes. A small amount spent in this direction, at the outset of such construction, was well laid out.

Mr. W. Hardie (North Shields) asked if it did not occur to Mr. Chadwick that it would be advisable to put down in the fifth case a wrought iron annular tank. Something of this kind seemed to him to be advisable on treacherous ground. He had not had anything to do with such large tanks as that in connection with wrought iron, but he had lately been called upon to put down small wrought iron tanks on uncertain ground where there had been colliery workings. He found that, with small tanks up to 40 or 50 feet diameter, the cost of a wrought iron one compared very favorably with that of a brick and puddle tank, and the former was much more reliable, as it could be got at and repaired in case of any shrinkage of the ground, which in these cases often took place.

Mr. Chadwick, in reply, said of course he did not consider that such a paper as the one before them would be of a controversial character. No doubt the difficulties with regard to leaky tanks would differ in every particular case. The nature of the ground varied in different localities; and he did not expect that anyone present would have had troubles of exactly the same character as he had to contend with—viz., through old coal workings being so close to the foundation of the tank. Mr. Chester had informed them that he had had certain difficulties with some tanks, and he explained the manner in which he attempted to remedy them. For this they were indebted to him. No doubt when he began to pump the water out he would have to drain it over a large area in the immediate neighborhood; and when he started filling it in again the probability was that he would have to fill the same area. In the end, he seemed to have accomplished what he was desirous of getting—viz., the tank fairly water-tight. He (Mr. Chadwick) could assure Mr. Anderson that it was a great trouble to him to get his tanks right. For several years it caused him considerable anxiety; but he was amply repaid at the finish by having so far succeeded. He did not know that he should wish for anyone, if he were in difficulty, to send for him, because he did not think he cared about undertaking leaky tanks any more than was really necessary. Possibly Mr. Anderson would take on the work, and do it as effectively as anybody. Mr. Riley had spoken of having some difficulties in connection with a tank which was in close proximity to a tidal estuary; and he had asked him (Mr. Chadwick) whether, when the tanks were first made, it would not have been advisable to take further precautions. He could only say that he did not make the four tanks originally; he simply had the pleasure of repairing them. They were made by his predecessor, and therefore he could not say what took place at that time.

Mr. Riley said he had intended to ask whether there were any indications in the ground itself, at the bottom of the excavation, as to its faulty nature, or as to the difficulties likely to ensue, when the excavation was made, such as would have justified those who were constructing the tank in carrying the foundations to a greater depth, or taking additional precautions.

Mr. Chadwick said that, for a considerable portion round No. 4 tank, the wall was built almost absolutely on loose material—at least, so he found it when he did the repairs, and probaby it was there at the time of construction; but of course he could not say for certain, as it was built by his deceased predecessor. He found it necessary to go through the soft material. If they had done this before, the probability was that the tank would not have leaked; but he should not like to say this positively. One thing he believed—viz., that a lot of the holes were made by rats. He believed this for the best of all reasons—because he had seen the rats, not once, but many times. He did not see them actually come up the holes, but he saw them go down. Even if the walls had been made good, there might have been difficulties from this cause.

Mr. Hill had put a somewhat similar question, as to the foundation going deeper. In his paper he had stated that if good, hard stable ground could be obtained, well and good; if not, it was desirable to counteract, as far as possible, any faults of the ground by works of a suitable character. He, of course, could not say what should be their character in every case. It might be best to go to a greater depth; or it might be sufficient to drive piles, and put a layer of concrete on them. What would possibly be best in one case might not be so in another. Either going to a greater depth, to get a hard foundation, or some other suitable means should be adopted, even if it cost more than was anticipated. The repairs to tanks Nos. 3 and 4 cost no less than £1,200. He had to put in nearly 1,000 tons of concrete to make them good. In answer to Mr. Hardie's question with regard to tank No. 5, he took means to prevent that leaking by putting a floor of concrete right over the whole tank, which would, he thought, prevent rats coming up and water going down.

Electric Power in Belgian Works.

[A paper read by Mr. D. Selby-Bigge before the Brussels Steel and Iron Institute.]

Last May the author of these few notes had the honor of submitting to the Iron and Steel Institute a paper on "Electricity as a Motive Power in the Iron and Steel Industries," in which he treated the subject somewhat closely and at considerable length. Three months having barely elapsed, it would be difficult for him to find sufficient new matter from which to write an entirely new paper on the same subject without running the risk of frequently repeating himself; he will, therefore, abandon any idea of writing a fresh paper, and will ask the members of this Institute to consider the following notes in the light of a short supplementary communication relating to what has already been done in this country in the way of practical applications of electric power.

The attention of electrical engineers in England has of late been so much taken up with the design, laying down, and starting to work of central electric lighting stations in our different towns, and electric lighting work in general, that the question of applying electricity for power purposes has certainly not received at their hands the same amount of investigation that it has from our Belgian and Continental friends.

Such countries as Switzerland and Northern Italy are exceptionally situated as regards natural sources of power, such as water, and it was only to be expected that they should take a lead in transmitting electricity to be utilized for power purposes in the driving of factories, etc.; and, indeed, a considerable amount of work has already been carried out by the Oerlikon Company, Messrs. Ganz, of Buda Pesth; Messrs. Siemens & Halske, of Berlin; and many other well-known firms, in this direction.

The economy to be derived from driving factories or works electrically, utilizing water as our source of power, requires but little comment from the author, as the advantages cannot but be self-evident to any engineer; but electricity has done much to enhance the commercial value of water power. Hitherto valuable power in the shape of waterfalls, situated in distant hills and inaccessible places, has been allowed to run to waste for years, and would be doing so still were it not for the advent of electricity, which has provided such simple and economical means for the conversion of this power, its transmission over enormous distances with trifling loss, and its application to almost any industrial undertaking at the far end of the line. The great Niagara scheme will doubtless furnish the best illustration of such a utilization of force.

The author has often thought that in countries where no very large water powers exist, such as the powers available in our counties of Lancashire and Yorkshire, turbine dynamos might be laid down at the different falls, and the power distributed to one collective center, where the greatest demand for current would arise. In this way many falls which, though formerly employed in the driving of factories, have been abandoned owing to their distance from main lines, and high railway dues, would again be brought into use. There are, however, many, if not the majority of countries, in which water powers are few and far between, and the next best means for the economical driving of works has to be considered. The author has already pointed out, and laid great stress upon, the utilization of waste furnace gases for producing steam in the boilers connected with the electric generating plant. In those cases where such a course is feasible, the cost of production per unit of electrical energy must necessarily be very low, and in order to arrive at a figure, it would be necessary to put a fixed value upon the quantity of waste gases used for firing the boilers, providing steam for running electric generators at a fixed load and for a given time. The cost of wages, oil, waste, upkeep and incidentals could be arrived at in the ordinary manner.

The question of cost of production of electricity to be employed in driving engineering works, steel works, shipyards and factories of any description must necessarily be of the first importance when considering an application of electric power; and in order to convey an accurate idea of the probable cost, the author will refer to some of the Board of Trade returns of electric lighting stations in England for 1893, showing what has been the cost of production to different companies:

		Cost of Pro'uction and Distribution per Unit Delivered to Consumers.				
Name of Company.	Total Horse Power Capacity of Engines.	Coal.	Oil, Waste, Water, Engine Room. Stores, and Carbons.	Salaries of Engineers and Wages.	Repairs and Maintenance.	Total.
			Low Tension.			
		d.	d.	d.	d.	d.
Liverpool	3,800	0.93	0.16	0.38	0.64	2.11
Westminster	4,530	0.78	0.19	0.95	0.35	2.27
			High Tension.			
Newcastle Dist.	1,200	0.83	0.28	0.85	0.14	2.10
N'c'stle Supply.	1,200	0.63	0.18	0.77	0.53	2.11

From the above table it will be seen that the cost of production, including coal, oil, waste, water, salaries of engineers and wages, repairs and maintenance, amount, in the case of the Liverpool Company, to 2.11d., and in the Newcastle Companies to very much the same figure. The Westminster Company has a cost of production of 2.27d. These figures are about the lowest that have yet been attained in England, where coal has been used in the production of electricity.

From the figures given above, the ratio of the expenditure for coal compared with the total cost of production can be deduced, and will be found very interesting. The Newcastle Supply Company has the very low figure of .63d. out of 2.11d. set down for coal, but coals are sometimes cheap at Newcastle, and this is perhaps an exceptional case. It is hardly correct to compare an electric power station with an electric lighting station, but it may be taken that in power work where it is possible to use larger generators than is usually advisable in electric lighting stations, the cost of production should be rather less than more, and when waste gases are available the cost of production should certainly not exceed 1d. per unit of 1,000 watt hours.

In laying out new works which are intended to be driven electrically, or even in remodelling old ones, it is necessary to have a correct knowledge of what working efficiencies one may reasonably expect from various sized dynamos and motors, in order to be able to form an exact opinion as to the power it is necessary to provide in order to drive the works. The author's own experience in these matters would lead him to suggest that for large sized power generating dynamos of 300-horse power, 500-horse power, 800-horse power, and 1,000-horse power, an efficiency of between 90 per cent. and 92 per cent. may be expected.

In the case of motors, the following:

For 3-horse power motors an efficiency of 78 per cent.
" 5 " " " 80 "
" 8 " " " 84 "
" 11 " " " 86 "
" 16 " " " 87 "
" 20 " " " 87 "
" 40 " " " 89 "

As to the loss in transmission through heating of cables, leakage, etc., this should not exceed 3 per cent. in cases where the motors are situated at distances from the generating source of not more than 300 yards, and 5 or 6 per cent. in cases where the distance does not exceed 500 yards; this, however, cannot be taken as a hard and fast rule for every case, but it will be found to apply in the case of most works, and the expenditure of copper in the mains will not be found to be prohibitive.

The main and great advantages to be derived from electric driving in works may be summarized as the following:

1. The concentration in one highly economical plant of the generation of power for the whole of the works, and great reduction in coal consumed per unit of work done.

2. Reduction in wages, owing to the very small number of officials required in connection with such a plant.

3. Transmission of the energy generated, with very trifling loss, to the different parts of the works.

4. Absence of main shafting, countershafting, pulleys, bearings and belts, and heavy cost of upkeep in connection therewith.

5. Absence of long lengths of steam pipes, and losses due to condensation.

6. Absence of scattered and separate boilers.

7. Absolute control over the economical running of the works owing to the self-indicating nature of electric motors, and the immediate detection of any undue losses which so often occur in mechanical forms of power transmission.

8. Great economy in work of an intermittent nature and varying loads, a direct proportion between the indicated horse power of generating engine and work given out by motors being obtained.

9. Very small cost and size of foundations involved in works driven electrically.

10. Great facility for alterations and extensions, without any modification being necessary to the original plant.

The points referred to above are perhaps the most salient, but there are many others which appear on the surface in practical work.

The whole contention of the author in advocating electricity as the right and proper agent for operating new works, and as a means whereby old works can be remodelled, may be summarized by the one word, "economy." In no country, perhaps, have engineers looked more thoroughly and closely into the economics of electricity as applied to power work than in Belgium, and the author trusts that reference by him to works driven by electricity in this country may not be out of place at the present meeting. In the first instance he would refer to an installation which has now been at work for some considerable time—viz., that of the National Arms Factory at Herstal, near Liége. To give a full account of these important works would necessitate a paper to be written solely for this purpose; the author will therefore confine himself to giving a brief description of them, with a few figures as to results obtained.

Mr. Leon Castermans, in a communication which was published in the *Revue Universelle des Mines*, stated that towards the end of 1886 the principal arms manufacturers at Liége formed a syndicate with the intention of laying down works to carry out, in a rapid manner, important orders for guns. A company was eventually formed, under the title of the Fabrique Nationale d'Armes de Guerre, and an order was given to this company for 150,000 to 200,000 rifles. In order to carry out this work, the society determined to lay down works provided with all the latest improvements and up to date in every respect. The works were to be capable of turning out 250 rifles in 12 working hours. Two years were allowed for completing the installation of these works, and two years for the construction of the rifles. In 1890 a plan was submitted for laying down works—all the different means of power transmission were minutely gone into, and electricity was eventually adopted as the sole power to be employed for driving the works. At this time there were no works of such importance running solely by electricity, and a precedent did not exist. The Compagnie Internationale d'Electricité went, however, most closely into the matter, with the result that they were able to offer to the syndicate absolute guarantees for successful working, which has since been fully realized. When these works were started the Compagnie Internationale d'Electricité laid down—

9	motors of	16-horse power	=	144-horse power.
2	" "	21 "	=	42 "
2	" "	37 "	=	74 "
	Total.....			260

For each motor the Compagnie Internationale d'Electricité guaranteed—for the 16-horse power, a commercial efficiency of 87 per cent.; for the 21-horse power, a commercial efficiency of 87 per cent.; for the 37-horse power, a commercial efficiency of 89 per cent., so that the available power would be produced by an initial power of—

$$\frac{144}{0.87} = 165.5$$

$$\frac{42}{0.87} = 48.3$$

$$\frac{74}{0.89} = 83.1$$

Total..... 296.9-horse power.

As the loss by canalization would not be greater than 2 per cent.,

$$\frac{296.9}{0.98} = 303\text{-horse power.}$$

at the dynamo terminals.

In addition to the above there was a large amount of lighting to be considered, and the power eventually adopted was an engine and dynamo combined of 500-horse power. This dynamo is of the shunt-wound type, and suitable for a tension of 125 volts; there are 20 pole pieces arranged in the form of a circle round the armature, and allowing a play of 6 millimeters to the latter. The armature, on account of its large dimensions, some 17 ft., had to be built up *in situ*. The current is taken from two commutators, one on either side of the armature, by 80 metallic brushes; the current is taken away to the main distributing switchboard by four underground cables.

The commercial efficiency, that is to say, the ratio between the electric energy available and the energy transmitted to the shaft by the engine, was guaranteed to be 90 per cent.

The carcase, which is in steel, of the dynamo weighs 10 tons; the armature alone weighs 10 tons; the copper in the magnet weighs 2 tons, and the armature coils 600 kilos.

The particular characteristic of this dynamo is that not only is it driven direct by the steam engine, but that the armature itself forms the flywheel of the engine.

The motors about the works drive different line shafts. The efficiency of transmission, that is to say, the ratio between the power available and the effective horse power developed by the steam engine, is given by the product of the three efficiencies:

90	per cent.	guaranteed	for the	dynamo.
98	"	"	"	conductors.
87	"	"	"	motors.

= 76.6 per cent.

The installation at Herstal has now been running continuously for three years, and until recently the entire works depended solely on the running of this single dynamo, both for light and power. About 2,000 hands are employed at the works. Up to the present, the large dynamo has never been the cause of cessation from work for a single minute. The installation has of late been considerably extended, and an additional 300-horse power plant has been laid down. The speed of the large engine and dynamo is only 66 revolutions per minute. The engine employed, being of the Corliss compound condensing type, was built by Messrs. Van de Kerkchove, while the dynamo was constructed by the Compagnie Internationale d'Electricité, under the direction of Mr. H. Pieper. The 300-horse power plant consists of a combined Willans engine and Pieper dynamo, running at about 350 revolutions per minute, and it is interesting to compare the results obtained with these two engines.

The efficiency of the Corliss combined plant—that is to say, the efficiency of the engine and dynamo taken together under full load, is about 77 per cent.

The dry steam consumption of the engine per indicated horse power per hour = 14.34 lbs.

The dry steam consumption of the engine per electrical horse power per hour = 18.75 lbs.

On the other hand, we get the highest efficiency from the quick-running plant. The efficiency of the Willans engine and dynamo combined at full load is about 85 per cent.

Dry steam consumption per indicated horse power per hour = 16½ lbs.

Dry steam consumption per electrical horse power per hour = 18.19 lbs.

Anyone visiting the installation at Herstal cannot fail to be struck with the wonderful organization in the works, and the result obtained during the past three years in driving these works electrically has been an unqualified success.

At the zinc works of the Vieille Montagne Company, near Jemeppe, a large electric power installation has recently been laid down. The works were formerly driven by a large number of steam engines, which took from 60 to 88 lbs. of steam per indicated horse power per hour to drive them, and required a number of engineers to attend to them.

The questions of driving the works by means of hydraulic power, compressed air and electricity were examined in turn, and it was decided to lay down a regular central power station, and to drive the works by means of electricity. The station is placed alongside the railway, so that coal may be brought right up to the boiler house by truck. Three Babcock & Wilcox boilers have been laid down—one acting as spare, while the other two provide steam for a 600-horse power compound condensing engine, on the Friekart system, built by the Société Cockerill, at Seraing, which drives direct a Pieper flywheel dynamo of 600-horse power at a speed of 80 revolutions per minute. The dynamo is wound for a pressure of 500 volts. Every provision is made in the engine house for a second section of 600-horse power, of a similar character to the first. The water from the Meuse, situated at a distance of 2,700 meters from the generating station, is pumped to the works by a 45-horse power motor, and the current is further utilized in operating two electric wharf cranes for loading and unloading the boats. The motors laid down at present are of the following sizes:

5	motors of	1	horse power.	2	motors of	10½	horse power.
7	"	2	"	4	"	14	"
6	"	3½	"	2	"	45	"
6	"	5	"	1	"	64	"
4	"	7	"				

It is now proposed to add the following motors:

1 motor of 80 horse power.		5 motors of	1 horse power.
1 "	14 "	1 "	10 "

The current is taken from the main generator to the main power switchboard, and is carried through 18 circuits to distributing boards in the works.

In addition to the power, there are 75 arc lamps and 500 incandescent lamps in the works. As the tension of 500 volts is too high for the latter, a continuous current transformer is used, which reduces the pressure to 100 volts. During the daytime this transformer charges a battery of accumulators.

The motors drive, amongst other things, joiners' shops, forges, fans, machine tools, saws, pumps, lifts, washing machines, crushing machines, brick-making machines, etc.

Efficiency of the Installation.

The efficiency of the steam engine is.....	90	per cent.
" " generating dynamo.....	90	"
" " circuits at full load.....	98	"
" " motors.....	86	"

which gives a total efficiency of 0.685.

Such are briefly the outlines of the Vieille Montagne installation. Electric power installations have also been laid down, and are working most successfully, at the Royal Arms Factory at Liége, where the coa' consumption has been much reduced; at the works of Messrs. Dietrich & Co., at Luneville; and at the celebrated glass works of the Val St. Lambert. At this last place there are 6 motors, 86 arc lamps and 1,100 incandescent lights.

The author thinks that it has now been shown that electricity has passsed out of its experimental stage, as far as regards its suitability for driving the various classes of works; and, in conclusion, trusts that these few very unpretentious notes may have proved a source of interest to the members of the Iron and Steel Institute.

The Prevention of Electrolysis.

At the annual meeting of the American Water Works Association, a report from the special committee appointed to consider the matter of the electrolyzation of water mains was submitted by Mr. Benzenberg. The recommendations submitted were:

To accomplish the prevention of electrolysis it is but necessary to prevent the pipe at any point from becoming positive to the rail or any other possible conductor. Whether the pipe is positive or not can be easily determined by a few observations with a voltmeter at points radiating out from the power house and along the line, where, by a perceptible difference in the potential between rails, the existence of poor or defective rail bonds is located. The facts and the points where the pipe is positive having been settled, the railway company should not lose a moment to re-establish the proper conditions for the protection of the pipe.

If not already provided, ample and suitable connection by an insulated cable should at once be made between the pipe and the generator to afford the least resistance for the proper escape of the current to its destination. If this has already been supplied, or the pipe is still positive, the rail bonds at such points should be perfected, and if the conditions are such that an increase of the section or number of such bonds will not entirely remove the difficulty, proper and suitable metallic connections should be made at such places between the pipe and rail so as to permit the turn of the current to the rail until the proper equilibrium, dependent upon the relative resistance, has been established, without the necessity of passing the current through an electrolyte and of developing electrolytic action in the accomplishment of such result.

Insufficient rail section, inadequate return feeders, or especially wet soil, presenting an easy avenue for the current to reach the pipe, may make it necessary to add to the number of such connections, but they should only be made where the pipe is positive, in order to relieve the pipe, and for no other purposes. If this method be followed no damage, it seems, can arise to the pipe, but, to the contrary, the best possible protection given it against an agent whose permeating power it is impossible entirely to escape.

The only question which may arise in connection herewith is as to the uniform conductivity of the pipe, whether there is sufficient resistance in the lead joints to cause some of the current to pass around and in doing so produce electrolytic action.

In a measurement made recently at the lead joint of an 8-inch water main in front of the power house of the Milwaukee Street Railway Company, through which main 16 per cent. of the entire output of the station (or 421 amperes) is being returned, (31 per cent. being the entire amount returned through the water mains), a drop of potential of but 0.0198 volt was found to exist between the ends of the pipe, indicating a resistance of 0.000047 ohm, certainly not sufficient to produce electrolysis even with the most favorable conditions existing at the joint.

But, do any favorable conditions exist? Professor Jackson, by his great number of experiments, has established that "in no case is the corrosive action due to the electrolysis of water; where oxygen is liberated at the anode, it does not attack the iron;" and again: "In order to have the first electrolytic process go on (that is, direct electrolysis of iron) a soluble iron salt must be present in the soil, reaching from anode to cathode. The analysis of street soils shows no such salts."

Corrosion at the joints, therefore, can only be caused by the electrolysis of the soluble salts heretofore mentioned, if they exist between the hub end and the adjoining pipe at the joint. A most careful examination of the pipes and the lead joint in the 8-inch main above referred to, did not show the least perceptible action of corrosion, although the main had been used as a conductor for years. It does not seem, therefore, that there is the least call for any anxiety that corrosive electrolytic action may take place at the lead joints, and, hence, a water main of like diameter may safely be considered to possess a uniform conductivity throughout and capable of conducting without injury so much of the current as under the law of divided circuits it cannot avoid conveying.

The 8-inch water pipe, where the same is connected by a 500,000 circular mil cable to the generator, was subjected on either side of the connection, in and under the clamps, to a most careful scrutiny and examination, but, notwithstanding the clamp and the cable had not been touched for 15 months, not even the least discernible change could be detected at any point. Where the iron pipe had been filed to form a contact with the clamp, the fine markings of the file were as sharp and distinct as on the day they were made. Other connections between the rails and pipe which were examined were found to be in equally good condition, and all possible information obtained so far indicates that all corrosive electrolytic action on or along the pipes has been arrested.

Undoubtedly electric street railway companies will soon, if they have not already, learn to appreciate the economy stored in a perfect return circuit of least possible resistance, and perfect, by improved copper bonds and return cable feeders, their present, in many instances, inadequate system.

The line of inquiry and investigation for the waterworks engineer to pursue and the remedy, if needed, to be demanded at the hands of the railway company has been made clear at least by the investigations and experiments which have been made; and he can now by his own observation ascertain whether or not any part of his pipe system is endangered.

A Ten-Candle Lamp for Use in Photometry.

[By Mr. A. Vernon Harcourt, before the Physical Section of the British Association.]

The author has in former years brought before this Section a burner consuming a mixture of air with pentane vapor, and lamps consuming pentane vapor, which gave a constant amount of light equal to that of an average standard candle. When so small a light is used in the ordinary photometry of coal gas, errors from defects in the adjustment of the photometer, or from slight haziness of the atmosphere of the testing-place, are greater than when a light is used more nearly of the same magnitude as that of the gas-flame which is measured. A light of 10 candles is well suited for the pupose. It has been shown that such a light can be obtained from an Argand gas burner consuming air saturated with the vapor of pentane; and a gas burner has been proposed for use which is well adapted for this purpose, except perhaps in being of a rather complex structure. But to supply air saturated with pentane vapor at a steady pressure, there is needed a gasholder of a few cubic feet capacity. The addition of such a holder to the apparatus makes it more costly, and not easily portable. It has been shown that great variations may occur in the proportions of pentane and air consumed by the gas burner without materially affecting the light given out by the lower part of the gas flame. The admixture of air is, however, unnecessary, since at a moderate temperature pentane can be volatilized without there being any necessity for reducing the atmospheric pressure by the admixture of another gas.

The improved lamp [shown] is on the same principle as the one-candle lamp devised by the author seven years ago. The wick is raised or depressed by the ordinary rack-and-pinion movement; the lower end of it dipping into pentane in the body of the lamp, while the upper end is warmed by the heat conducted down from the flame. In the 10-

candle burner the wick fills the circular interspace between the central and outer tubes of the Argand. The only difference between this and an ordinary lamp is that the wick does not come near the flame, and needs no cutting or renewal; nor does the smoothness or roughness of its upper surface affect the burning. The dimensions of the lamp and chimney, upon which the air currents inside and outside the flame depend, have been determined by experiment, so as to produce a bright and steady flame. The entrance to the inner tube is through a triangular opening, as in the usual construction of such lamps. It was found that the free admission of air at this entrance caused an inequality in the flame—two peaks appearing on either side of the place for the admission of air. To steady and regulate the inflow of air at this point, a cylindrical case is fixed round the lower part of the tube, into which air is admitted through a circular hole 15 mm. in diameter.

The flame of a rich gas burning from a wide opening is of the color of candle light, even when an abundant supply of air is provided on both sides of the flame. The light of a good gas burner is less red or more blue than this; and it is important for the photometry of coal gas that the standard light employed shonld be as nearly as possible of the same color as the light of the gas flame. The light of the lamp has been brought to this color by a small admission of air below the point of combustion. Twelve holes, each 3 mm. in diameter, have been drilled through the outer tube, 15 mm. below the top. The draught of the chimney is sufficient to determine an entry of air through these holes, which, happening under fixed conditions, is constant in amount. A short cylindrical screen goes round the chimney, the bottom of which is 60 mm. above the surface of the burner; and both screen and chimney are surrounded by a pentagonal shade, four panels of which are filled with blue glass, while the fifth, which is turned towards the disc of the photometer, is filled half way down with a metal plate, which, overlapping the inner screen, allows only the light from the lower part of the flame to fall on the disc of the photometer. By supporting the lamp at such a height that the bottom of the screen is level with the center of the disc, errors of parallax are avoided. Mr. Sugg, I believe, observed and Mr. Dibdin has proved that, with the flame of the Argand burner, the light thus given by the lower part is independent, within wide limits, of the total height of the flame. The observation is true not only for a particular burner, but for many, and probaby for most, Argand burners.

Many alterations have been made in the structure of this lamp; and it has generally been found, though not always with equal exactness, that the height of the flame did not affect the light emitted from its lower part. As the lamp is now arranged, the height of the flame can be observed through the blue glass panels; and whether the top is just visible above the circular screen or rises to the top of the panel, the light which falls upon the disc of the photometer does not alter measurably. The adjustment of the light to the value of 10 candles—in other words, the adjustment of the height of the circular screen—has been effected by a number of comparisons between the lamp and the one-candle pentane standard.

Recovery of Bye-Products in Coke Manufacture.

The current issue of *Iron Age* contains a most readable article entitled "Coking, with Recovery of Bye-Products," which is largely founded on statistics collected by Mr. John F. Wilcox, of Pittsburgh, during a recent prolonged visit by that gentleman in Europe. In commenting on the "Yield of Bye-Products," our authority furnishes the following interesting statistics:

A very considerable difference exists between the various systems of coke ovens used in Europe in the quantity of bye-products obtained. The following data, collected by Mr. Wilcox, give the comparative yield of bye-products obtained from similar coals by different systems covering the same period of time. This comparison speaks for itself. It has shown the superiority of the Otto to the other systems. The figures are taken from the books of the different companies, and in the case of Mr. Huessener were immediately after the plant had been thoroughly repaired, while the Otto ovens had been running for a period of 3½ years with no repairs whatever. The coals were substantially the same, with the exception of Seibel, which should have a still larger yield than that of any other records, by the admission of their own representatives:

System	Time.	Ammonia Sulphate.	Tar. Per Cent.
Otto-Hoffman	Oct. '92–Mar. '93	1.18	3.53
Carves-Huessener...	Oct. '92–Feb. '93	1.00	1.81
Semet-Solvay	Oct. '92–Mar. '93	0.61	1.60
Seibel	Oct. '92–Mar. '93	0.50	3.00

All the works visited in Europe claim profits and look prosperous. How these profits vary can be seen by examining the table of comparative yields. If the Seibel people claim a profit, and they are running to-day and have run for years, how much more in comparison must be the profit of the Otto people?

It may be of interest to present the following data concerning the work of the Otto-Hoffman plant at No. 2 Colliery, Recklinghausen, near Bochum, Westphalia. It consists of 60 ovens and the very substantial condensation plant shown in our engravings. It has run 3½ years and thus far has had no repairs. The coal is poor, as the following analysis shows: Volatile matter, 29.64 per cent.; fixed carbon, 59.35 per cent.; and ash, 10.64 per cent. The yield in coke varies from 74 to 76 per cent., and the yield of breeze 2 per cent. The coke is controlled by the mining company, who limit the time at which the ovens shall be run. If it were extended to 48 hours, the coke would be better. The charge per oven is 6.76 net tons of dry coal, which carries 12½ per cent. of water, and the average running time is 40.8 hours. The ovens, which have the dimensions which are standard in Westphalia, are 21.5 inches at the small end and 25.3 inches at the large end. They are 32.8 feet long and 5.7 feet high. The following is the crew required to run the plant:

Men employed—

1 foreman at $37.50 per month and house.
1 assistant at 86 cents per day and house.

Coke ovens—

Day.	Night.		Per Man per Oven.
3	3	Levelers and quenchers	5.7
2	2	Door closers	5.7
2	2	Coal fillers.....	5.4
2	2	Trammers.....	5.2
1	1	Engineer (pusher). ...	5.7
10	10		

Labor per oven filling, tramming, closing, leveling, pushing and quenching is $55\frac{4}{10}$ cents per oven.

Day.	Night.	
3	3	Loaders, paid 4 cents per ton.
1	1	Removing breeze, 76 cents per day.

Labor per net ton of coke, including superintendent and loading on cars, $16\frac{5}{10}$ cents, based on six months' run. Ovens drawn, 5,394; coke produced, blast furnace, 19,812; crushed, 5,635; total, 25,447 gross tons; net tons, 27,992. Coal used, 36,550 net tons. Total coke, 76.5 per cent.

Condensation Plant.

1 foreman.....	$65.40	per month and house.
1 assistant.....	41.70	" "

Both Shifts Together.

2 engineers, at 83 cents.....	$1.66
4 men in ammonia factory, at 80 cents....	3.20
2 valve men, at 83 cents.....	1.66
2 pipe cleaners, at 78 cents.....	1.56
1 water tender, at 82 cents.....	82
Total.....	$8.90
Total labor for six months.....	$2,266.85
Sulphuric acid required 431 T. at $6.80	2,930.80
Sundries.....	610.00
Total.....	$5,807.65

Product of Recklinghausen No. 2 for Half Year Ending March 31, 1893.

	Tons.	Per Cent.
Ammonia sulphate.....	431.3	1.18
Tar.....	1,114.8	3.05
Pitch.....	173.0	48.0
Blast furnace coke	19,812.0	54.2
Crushed coke.....	5,635.0	15.1
Coal equivalent of gas.....	4,380.0	12.0
Total.....	31,546.1	86.01

Gases.—After heating the ovens and furnishing steam for the condensation plant, there is enough gas to develop 360-horse power, 290 of which is used by the mining company to run their washing, screening and separating plant. There are two water tube boilers, 180-horse power each, similar to the Babcock & Wilcox. The average daily excess gas is 1,112,000 cubic feet.

Yield of Tar and Ammonia.

Month.	Year.	Pitch.	Tar.	Ammonium Sulphate.
October	1892	0.67	3.00	1.16
November	1892	0.64	3.00	1.17
December	1892	0.46	3.20	1.19
January	1893	0.29	3.02	1.16
February	1893	0.36	3.08	1.20
March	1893	0.43	3.01	1.21

Benzole..... 0.3 to 0.7 per cent.

Present Value of Bye-Products—End of March, 1894.

Ammonium sulphate, per pound	$0.025
Tar, per net ton	6.43
Pitch, per ton	5.14
Benzole, per gallon	0.52
Sulphuric acid 60 B. per net ton	6.80
Blast furnace coke (oven)	2.40
Foundry coke	3.00
Crushed coke	3.15
Coking coal	1.20

Coke Produced and Ovens Turned Out.

Month.	Dry Coal Coked. Net Tons.	Furnace Coke.	Crushed Coke. 1	2	3	4		Number Ovens Drawn.
Oct.	6,338	3,503	451	429	250	110	1,240	937
Nov.	5,954	3,456	335	478	231	104	1,148	880
Dec.	6,074	3,547	429	363	187	88	1,067	889
Jan.	6,122	3,938	368	225	151	95	839	905
Feb.	5,490	3,300	319	319	291	107	1,036	812
Mar.	5,568	4,048	390	225	209	126	950	971

The ovens are 17 inches wide at one end and 13.5 inches at the other end; the length is 30 feet and the height 5 feet. The ovens take a charge of 4.6 net tons dry coal. The amount of gas produced is 4,236,000 cubic feet daily. Of this five-sevenths is used at the ovens, the excess of gas being 1,210,000 cubic feet. The power required for the condensation plant is 50-horse power. The five double cylinder boilers, of a French type, with 915 aggregate horse power, are heated by waste gas. In addition to this some gas is used for drying ammonium sulphate. These boilers are situated at the rolling mill, about a quarter of a mile distant. The following are the results:

Average Figures for Year 1892–1893.

Number of ovens run	2,716 net tons.
Running time	32.1 hours.
Charge per oven (dry coal)	4.6 net tons.
Sulphate of ammonia per month (average).	163 net tons.
Tar per month (average)	442.6 net tons.
Pitch	90 net tons.
Price sulphate of ammonia, per pound, 0.026	$52 00
Tar	6 00

Percentage of Bye-Products.

Sulphate of ammonia	1.337 per cent.
Tar	3.540 "
Pitch	0.720 "

Profits.—Profits from condensation plant alone, including everything except taxes, is $71,450.80 for the past year. The ground is gradually settling, but no repairs in the ovens have been necessary, and no trouble has been experienced.

This plant costs complete, including ovens, condensation plant, laboratory, tools, electric light, in fact, every detail complete, and the plant put in operation, 750,000 marks, or $181,000. This includes Dr. Otto & Co.'s profits for erection and royalties. Dr. Otto & Co. erected the plant, and after a certain number of years turned it over to the colliery free of charge.

The following data were collected by Mr. Wilcox at the coke works in Mahr. Ostra: The coal is not very good, being high in ash, and contains 15 per cent. of water. Of the coal used 81 per cent. is washed and 19 per cent. not washed. Loss in washing coal is 15 per cent. Coal very meager. The yield is 70 per cent. of blast furnace coke and 4 per cent. of small coke and breeze. Although the plant has been running for 3½ years, the repairs have been practically nothing. The percentage of water in the coke is 1.5 per cent.

THE proprietors of the Hastings (Neb.) Gas Light Company have authorized a reduction in the selling rate to $1.60 per 1,000 cubic feet.

Drilling for Oil and Natural Gas in the Vicinity of Philadelphia.

[A paper read by Prof. Oscar C. S. Carter, before the Chemical Section of the Franklin Institute.]

There have been several attempts made recently to drill for oil and natural gas near Philadelphia, notwithstanding warnings of failure from scientific experts. There seems to be a kind of fascination and an air of mystery in searching for gold, silver, oil or natural gas, which, apart from their value, lead men to spend much money and time in prospecting localities, which have never yielded anything in the past, and, from a geological standpoint, will never yield anything valuable in the future. True it is, beyond all doubt, that oil has been found in the older as well as the newer rocks, and nearly every geological horizon from the silurian up to and including the tertiary has yielded oil. It is not, however, evenly distributed through all formations. The silurian, devonian and tertiary rocks have yielded most of the oil of the world. It was formerly thought that the devonian rocks were the oldest that would yield oil, but when gas was discovered in the Findlay field and oil in the Lima belt in Ohio, in 1886, it brought the limit of the oil bearing rocks down into the lower silurian formation. The oil of the Lima belt was found in the Trenton limestone, not very far distant in a geological sense from the archæan granite. This was a great surprise to many who did not expect oil would be found in such a low horizon near the bed rock of the continent. The Trenton limestone of Ohio is now regarded as one of the most important sources of oil and natural gas in the world. In Indiana, in July, 1886, the combined flow of all the wells from actual testing and estimates was found to be 500,000,000 cubic feet of gas per day. Many of the gas wells have averaged 1,000,000 cubic feet per day. The Karg well is the largest of the Findlay district, and it is estimated that 1,500,000,000 cubic feet of gas from this well escaped utilization and were entirely wasted. In many small towns, over 700,000 cubic feet per day were wasted in working up booms and furthering real estate schemes. Laws have been framed for every conceivable purpose, and the rights of man are zealously guarded, but nothing has been done to prevent the criminal waste of Nature's richest gifts, which, in a few years, will exist only in history. The oil of the Trenton field is equally abundant; many of the wells have yielded 1,000 barrels per day, and the product of the Lima belt for 1888 was 9,682,683 barrels of oil. The Lima oil is black and heavy and contains sulphur compounds which have a disagreeable odor and are removed with difficulty in the refining process. Particular mention has been made of this Trenton limestone, because we have the silurian limestone, of which the Trenton is a part, within a few miles of Philadelphia.

The Schuylkill or Chester Valley is an immense trough of jointed, fissured and steeply dipping limestone. If oil or gas ever existed there it escaped ages ago. The limestone of Ohio, on the contrary, is as level as a floor, the slope being but 2 or 3 feet to the mile. It must also be remembered that oil at Lima is found at a depth of 1,300 feet. It takes 60 days to drill a well, while the silurian limestone near Philadelphia is found on the surface outcropping along the Schuylkill at angles of from 45° to 60° for a distance of four miles below Norristown. Ever since Trenton oil has been found the sound of the drill has been heard in every State from New England to the Rocky Mountains, searching for this new oil and gas rock of Ohio. It is easily reached in many States, but does not contain oil, because the conditions are not the same. The Trenton limestone is only productive in the part which is a dolomite or magnesian limestone; the non-magnesian limestone has not yielded oil. Besides being horizontal and porous, it must be favorably situated to the surrounding strata for the accumulation of oil.

One of the most interesting experimental wells for natural gas or oil was drilled at Fitzwatertown, twelve miles from Philadelphia. There were stories told in the past by the farmers of the vicinity of a slight scum of oil appearing on the water in the spring houses, and that bubbles of gas would come up through the water of the creeks, so that some were not surprised when operations were begun. Fitzwatertown is a country village on the Limestone Pike; the nearest railroad station is Edge Hill, on the Bethlehem branch of the Reading Railroad. The drilling was commenced by a stock company, and hundreds of acres were leased. The sinking of the well began on an 8-acre farm owned by Elijah Lukens. The *Philadelphia Inquirer*, of February 16, 1890, says: "The drillers worked day and night from that time onward; many precautions to keep the work secret were inaugurated. The rig was boarded in, and a rudely painted sign, nailed on the outside, announced that without a permit from the President, admission could not be obtained. The story the gossips talked about was this: Three weeks

ago the driller, James H. Moore, and foreman Sclocomb noticed a regular puff, puff, whenever the drill was lifted. Experience in the Bradford county fields led them to believe that natural gas had been struck, though at a depth of but 400 feet they regarded this as improbable. A sort of cap or reservoir arrangement, constructed of tin and topped with a key and burner, was placed over the hole to allow an accumulation of gas. In half an hour the key was turned and a match applied to the burner; a steady, mellow flame resulted when the key was half turned on. At full head the pressure was so great that the flame was extinguished. The company, though jubilant at the success already attained, made another test with a larger reservoir, and the result more than satisfied their expectations."

I visited this well May 24, 1890. Three men were at work with a regular oil well derrick and apparatus and a small engine of 15-horse power. In drilling they reached water or quicksand at a depth of ten feet; then limestone was reached. The strata here are nearly vertical, and much trouble was experienced as pieces broke off and fell down the well. There was much difficulty in keeping the drill hole straight. It is much easier to drill horizontal strata.

The drill passed through 330 feet of silurian limestone before the so-called Potsdam sandstone was struck; the well was then probably about 460 feet deep. An examination of the drillings showed me that the drill was then passing through the so-called Potsdam sandstone, which has never yielded oil or gas in any locality; about 130 feet of Potsdam had been drilled. The well was cased with iron pipe to a depth of 330 feet or through the limestone. It is a wet well; the water rises to within ten feet of the surface. The sand pump was put down that afternoon, and the well cleaned and a new drill put on, but not the slightest odor or indication of gas could be observed at the mouth of the well. The most interesting feature about the place was a pond of clear and sparkling water about twelve feet distant from the derrick; the sand or quicksand in the bottom was in continual motion. One of the workmen procured a pole, and on pushing it down through the sand, bubbles of gas came up by the hundred. There was a small gasometer of ten gallons capacity floating in the pond; it was furnished with a stop-cock. On turning this I noticed an odor of gas, and on lighting it found it burned with an almost invisible flame. You could scarcely, in fact, see it in daylight, but on approaching a splinter of wood to it, the wood at once took fire.

It may have been marsh gas. No analysis was ever made. There seemed to be no decomposing vegetable matter in the pond. The drillers were very sick of their work. After they had drilled 550 feet they left, but the contract stipulated that they were to drill 720 feet before stopping. If they stopped before that depth was reached, then the company was to have the use of his plant one day for each foot that remained to be drilled. The plant was finally sold at sheriff's sale, although the company was entitled to the use of it for 170 days. Nothing further was done, and the well was abandoned. Not long after the failure of the well at Fitzwatertown, a deep well was drilled for oil and gas in Buck's County, not far from Philadelphia, in the new red sandstone of triassic age. This well was over 1,000 feet deep, and passed through beds sandstone, red shale and slates. A bed of black slate, containing coaly matter, was encountered. This is the same bed of slate that was met with in drilling all the artesian wells at Lansdale, Montgomery County, Pa., in the new red sandstone (see *Franklin Institute Journal*, September, 1893). The same bed of coaly slate was passed through in drilling the Duffield well several miles distant, on the Stony Creek Railroad (see *Proceedings American Philosophical Society*, Vol. XXIX., May 25, 1891). Another experimental well for oil and gas was drilled at Valley Forge, in the Potsdam sandstone, with the usual result.

Not long afterward, there was reported a find of crude petroleum near Doylestown, Bucks County. It was announced that what seemed to be a rich crude oil was oozing out of the ground on the small farm of William Eisenhart. While Mr. Eisenhart was working in his cornfield, he came upon a pool of water covered with a heavy scum of oily substance. He found that a stream of oily fluid was oozing out of the ground and covering considerable space, finally finding its way to Cook's Run, a small stream running near by. Several citizens from Doylestown visited the place of the supposed rich discovery, and were outspoken in their belief that oil exists in paying quantities at no great distance below the surface. Mr. Eisenhart sent me a sample of this water for analysis. Qualitative tests showed much iron and organic matter, and a black substance held in suspension, but not the slightest trace of oil was present.

State Geologist Lesley tersely discusses the question where oil and gas will not be found in Pennsylvania, in the following words: "First of all, there can be no gas stored up in the oldest rocks. This at once settles the question in the negative for the whole southeastern third of the State. To bore for gas in Bucks, Montgomery, Philadelphia, Chester, Delaware, Lancaster, York or Adams counties would be simply absurd. Secondly, there can be no gas left underground where the old rocks have been turned upon edge and overturned, fractured and re-cemented, faulted and disturbed in a thousand ways. If there ever was any, it has long since found innumerable ways of escape into the atmosphere. This settles the question in the negative for all the counties of the great valley—Northampton, Lehigh, Berks, Lebanon, Dauphin, Cumberland and Franklin, as anyone can see by looking at the present condition of their limestone, slate, and sandstone formations. Thirdly, there is not the least chance that any gas is left underground in the greatly folded, faulted, crushed and hardened formations of the middle belt of the State—Carbon, Schuylkill, Lehigh, Luzerne, Columbia, Montour, Northumberland, Union, Snyder, Lycoming, Perry, Juniata, Mifflin, Center, Clinton, Huntingdon, Blair, Bedford and Fulton counties. Where the oil and gas rocks rise to the surface in these counties, as they do in a thousand places, they show that all their oil and gas has escaped long ago. Fourthly, where the rock formations lie pretty flat and have remained nearly undisturbed over extensive areas, as in Wayne and Susquehanna, parts of Pike and Lackawanna, Wyoming, Bradford, Tioga, Potter and all the counties west of the Allegheny Mountains—there is always a chance of finding gas (if not oil) at some depth beneath the surface, determined by the particular formation which appears at the surface; but, as yet, we have no satisfactory evidence of the existence of quantities of rock gas in any of these counties east of Potter. Fifthly, wherever the bituminous coal beds have been changed into anthracite or semi-bituminous coal, it is reasonable to suppose that the same agency which produced the change, whatever it was, must have acted upon the whole column of formations, including any possible gas rock at any depth. Sixthly, wherever rock oil has been found, there, and in the surrounding region, rock gas is sure to exist. In the deep Erie well, the Trenton was reached. In the Canada well, on the south shore of Lake Ontario, the Trenton was pierced. Several wells in New York State penetrated it. In no case has there been any profitable return of either oil or gas. And if this happens under the exceptionally good conditions in central and western New York, where the formation is very fossiliferous, lies nearly flat and can be easily reached, what chance is there of success for those who bore in the uplifted and dislocated and poorly fossiliferous strata of Pennsylvania? Where the Trenton is brought to the surface, it shows plainly that whatever petroleum or rock gas was once distilled from its fossil corals and shells has, ages ago, escaped from it."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

We are indebted to a correspondent at Sacramento, Cal., for the following: "The Oroville (Cal.) Gas, Electric Light and Power Company has been organized with a capital stock of $32,000, one-half of which is paid in. A purchase of the Oroville gas works from the executors of the late A. Pierce has been made, and the new Company assumed control on the 1st inst. As soon as possible the new proprietors, who are all local business men, will increase the plant by putting in an electric lighting equipment. The officers chosen were: Directors, Max Marks, F. H. Gray, W. E. Duncan, Jr., C. N. Schively, W. J. Schneider, J. C. Osgood and C.W. Putnam; President, Max Marks; Vice-President, F. H. Gray; Secretary, W. E. Duncan, Jr.; Treasurer, Bank of Oroville; Superintendent, Jas. Havey. The last named appointment is a very popular one, for Mr. Havey has been in charge of the gas works for years."

The annual meeting of the Providence (R. I.) Gas Company, which was held on the 3d inst., was marked by a small attendance, which no doubt can be traced to the fact that the meeting day was Labor Day. In fact, the Directors elected (they were the same as those who served last year) deferred the naming of officers for the ensuing year because the full Board was not present. The President, Mr. Royal C. Taft, directed the proceedings, the chief point of interest in which was the presentation of the annual report, which showed that during the past year 429,285,600 cubic feet of gas has been used in this city, an increase over the preceding 12 months of 9,385,500 cubic feet. The Company realized from the sale of coke, coal tar and ammoniacal liquor, $47,511.90; 10.75 miles of mains were laid during the year—or about two miles more than were laid in the preceding year—which brings the total mileage to 200. The number of meters in use is 17,900. Since the new franchise was secured, up to July of this year, the sum paid

to the city as a bonus amounted to $31,846.93. The report admits that the normal annual increase in the output of gas has not been maintained, owing to the discontinuance of 1,327 street lights by the city and the general depression in business. The indebtedness of the Company remains at $115,000, the same amount as reported a year ago.

CAPTAIN W. HENRY WHITE has agreed to represent in New York city the Western Gas Construction Company, of Fort Wayne, Ind., and that he will bring strength to the Company goes without saying. His headquarters, of course, are to be as usual in 32 Pine street, where he may be consulted on anything and everything pertaining to the Eastern business of the Fort Wayne folks.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has received the contract for an annealing room building for the Naugatuck Malleable Iron Company, of Naugatuck, Conn. The building is to be 94 feet wide and 175 feet long, with back walls and iron roof trusses to be covered with corrugated iron.

"OBSERVER" forwards the following report made by Mr. Chas. D. Jenkins, State Inspector of Gas and Gas Meters for Massachusetts, on the candle power of the arc lamps supplied to the town of Spencer, under the contract existing between the town and the Spencer Gas Company. The inspection was made at the direction of the Selectmen, who were of the opinion that the arcs were not up to the candle power (1,200) stipulated :

"Office of the Inspector of Gas and Gas Meters.

"To the Board of Selectmen, Spencer, Mass.—Gentlemen : I have to report the following tests made at Spencer, August 29, of the electric arc lights supplied the town. The candle power was taken at an angle of 45°, the greatest angle of efficiency. The ammeters in power room were read at the same time, the upper reading being the average of the old instrument, the lower that of the new one :

	South Circuit.	North Circuit.
Candle power.....	696	693
Ammeter, old.....	8.13	10.27
" new.....	5.11	9.79

These results were obtained within an hour of starting up. Another test was then made of the north circuit lamp, as follows : Candle power, 687 ; ammeter, old, 3.0 ; ammeter, new, resting on lowest point, did not register 3. After running about two hours, a Thomson-Houston ammeter was put in the north circuit and indicated an average of 6.5 amperes, which is about the current usually supplied 1,200-candle power lamps. On starting up, the Bell ammeters registered 13, for from 10 to 15 minutes, and then gradually fell. It is my opinion that the candle powers found are somewhat above those given by 1,200 nominal candle power lamps.—Very truly yours, C. D. JENKINS."

A MOVE in the right direction was recently made by the proprietors of the Seattle (Wash.) Gas and Electric Light Company when they decided to abolish the practice of charging for setting consumers' meters.

ON the 5th inst. a hearing was given in the Massachusetts State House, by the State Board of Gas and Electric Light Commissioners, on the petition of the Brookline Gas and Electric Light Company to increase its capital stock from $1,000,000 to $2,000,000 by the issue of 10,000 shares of new stock for the avowed purposes of increasing its plant and paying its debts. All the Commissioners were present. Albert Burrage appeared for the Brookline Company, and L. L. Scaife for the Union Mutual Life Insurance Company, of Portland, Me., argued in remonstrance. Mr. Scaife stated he appeared under and through Frank Sullivan Smith, of New York, counsel for the Insurance Company. Mr. Smith, who represented not only that Company, but also other interests in the remonstrance, had intended to be present at the hearing, but had been obliged to go West and could not return in time (he could not appear until the 10th inst.). Mr. Scaife asked for an adjournment until then. Mr. Burrage urged that the Board could allow the Company's side of the case to be heard without detriment to the remonstrants, and the Board decided to proceed with the investigation. Before proceeding further with the hearing, Mr. Scaife asked permission to present one objection which he claimed went to the root of the whole matter. There was no language in the Act under which the petition was made that would permit the increase of capital asked for at a single bound. The Act stated that the increase was to be made in such amounts and at such times as might from time to time be determined—not in a single amount, nor at one time. The point was a small one, but essential to the question of the Board's power in the matter. As the Act was a private one, that is, taking its rise not in the Legislature, but in the Company that asked for its enactment, it should be most carefully construed. It clearly indicated that the Company should proceed by successive increases, as it had previously done, and not by a single large increase. On that point the language of the Act was unambiguous and meant but one thing. In concluding his argument, Mr. Scaife cited numerous legal authorities in support of his position. Mr. Burrage declared that if the Brookline Company wished to increase its capital stock from $1,000,000 to $2,000,000, there was nothing in the statute to prevent the Company from doing so at once and by one amount. He was proceeding with his argument, when Mr. Scaife asked for the ruling of the Board on the point he had raised. After a short consultation the Board announced, through its chairman, that the remonstrants were at liberty to urge their point in any proceedings that they might wish to take later on, but that the question properly before the Board was whether it ought to proceed with its investigation, and it decided in the affirmative. Resuming the argument for the Company, Mr. Burrage said that in the conduct of the business of the Company in the early part of the year it was found desirable to secure an increase of capital, and the Company, therefore, obtained from the Legislature the necessary permission to increase it. At that time he learned that a minor stockholder intended to object to the increase, and he went carefully over the whole matter. Mr. Burrage then gave a long and detailed account of the legislation on the subject and of the subsequent action of the Directors and stockholders. After a discussion of the powers of the Board under the various statutes, including the so-called anti stock watering laws, he stated that there were in his opinion four things which the Board has to do, viz., to determine what amount is "reasonably requisite" to allow the Company upon its petition to fix the price of the stock to be issued, to name the place where the stock that is not taken shall be sold by auction, and to indicate in what papers the notice of such sale shall be published. The capital of the Company is $1,000,000, as already stated ; the bonds amount to $1,000,000 ; there is a floating indebtedness of $1,149,000, and there are bills payable amounting to between $50,000 and $60,000. Mr. Burrage said that the Company wished to pay off its debt and not to increase its plant. The point was that whenever the debts of a Company exceeded its capital the Directors were personally responsible ; consequently the Directors of the Brookline Company are each personally responsible for about $1,000,000, and they desired to be relieved of the responsibility. Mr. Burrage thought Mr. Scaife would find that the advantage to the minority stockholders of being relieved of the burden of interest caused by the present debt would more than offset the reduction of their relative importance to the entire amount of stock caused by the proposed increase in the capital. No argument was attempted by Mr. Scaife in reply, as he said he understood that the Board would give the remonstrants an opportunity to present their side later on. He merely called the attention of the Board to the fact that the question was not whether the Company should be allowed an increase of $1,000,000, but whether it should be permitted to increase its capital stock from $1,000,000 to $2,000,000, and in connection with this fact he suggested that the Board, in examining the condition of the Company, should find out whether it had really a full paid up capital of $1,000,000. An adjournment was then ordered to 10 A.M., Wednesday, September 19, when the hearing will be continued.

INFORMATION received from Racine, Wis., under date of September 8th, is to the effect that Mr. John Rodgers has disposed of all his interests in the Racine, Fond du Lac and Oshkosh Gas and Electric Light Companies ; also, that Mr. William Mainland will have charge of the Racine works. We are glad to add, however, that Mr. Rodgers will not retire from the gas business, for he has purchased a controlling interest in the property of the La Crosse (Wis.) Gas Light Company, and proposes to hereafter give his sole attention to the development thereof.

THE proprietors of the Seymour (Ind.) Gas Light and Coke Company have perfected arrangements with the owners of the local incandescent lighting concern whereby the two properties will in the future be under one management. The electric plant will be removed to a site adjoining the gas works.

THE Citizens Gas Light Company, of Wabash, Ind., has been incorporated with a capital of $30,000. Maurice S. Howe seems to be the prime mover in the enterprise.

SUPERINTENDENT CURRY, of the Albion (N. Y.) Gas Company, is greatly elated over the success that has been his portion in putting out gas cookers this season. Nor does he propose to stop at the point of having proved to the residents that gas is quite the thing for cooking purposes, for he is now engaged in the task of causing his customers to

experiment with gas fires for the intermittent or occasional heating of sitting rooms, bath rooms, etc.

THE dividends disbursed in August on shares of lighting enterprises largely held in San Francisco are as follows:

Name of Company.	Rate per Share.	Amount.
San Francisco Gas Light Company	$0.35	$35,000
Pacific Gas Improvement Company	.50	15,000
Central Gas Company....	1.00	20,000
Pacific Gas Lighting Company....	.30	6,000
Oakland Gas Company.....	.20	6,000
Edison Light and Power Company	.08	13,333
California Electric Light Company	.40	20,000

THE special election ordered by the East Albany (N. Y.) Gas Light Company for the purpose of filling vacancies in its executive management, resulted as follows: Directors, Smith Briggs, Frank Chamberlain, Jas. H. Miller, F. Alfred Sabbaton and P. A. Sabbaton; President, F. A. Sabbaton; Secretary, P. A. Sabbaton; Treasurer, J. H. Miller. It is not outside the possibilities that this Company will shortly pass into other hands.

RUMOR has it that Messrs. John Lamotte and John Vandergrift are considering the advisability of establishing a gas works at Chestertown, Maryland. Chestertown is on the right bank of Chester river, at a point perhaps 55 miles from Baltimore, with which city it is connected, so far as transportation goes, by a line of steamboats, which make daily trips. It can also be reached by the Kent County Railroad. Washington College (founded in 1782) is within its limits. While it is quite a thriving place, its population (certainly not in excess of 3,500) is hardly up to the point of sustaining a gas works.

THE application for an opposition gas franchise for St. Paul, Minn., asked for by Mr. Pugh and his associates, which was referred to the Committee on Gas of the City Council for investigation and report, has been reported on adversely, and the report of the Committee was subsequently agreed to by the Council. A summary of the case was received from a correspondent at St. Paul, and the same will be printed in our issue for next week.

THE sale of the Jamaica Plain (Mass.) Gas Company to the syndicate in control of the Brookline Company is announced, which looks to be one more step towards consolidating all the Companies in and around Boston. The Boston *Traveller* says that the price paid was $150 per share, which is an average of the market price of the shares for the past two years. According to the last annual report of the Board of Gas and Electric Light Commissioners, the capital stock of the Jamaica Plain Company is returned at $250,000, and its outstanding note or bonded indebtedness is said to be $20,000.

THLChicago gossipers have it that the Mutual Fuel Gas Company, acting under the recently acquired charter of the Universal Gas Company, will lay 50 miles of gas mains in the downtown district of Chicago. It is further asserted that Messrs. Clow & Sons have been awarded the contract to furnish the pipe, the contractors agreeing to deliver a goodly portion of the same by the 25th inst. Under the Universal ordinance it may charge, net, not in excess of $1 per 1,000 cubic feet for gas for illuminating purposes. Meanwhile holders of stocks in the old Chicago Companies are not very uneasy over the outcome of the proposed opposition, nor are the executive managements of the existing Companies very active in negotiating for control in the aforesaid Universal; for we presume its "rights" could be "bought for cash."

THE political purists of Boston are finding fault with the Board of Gas and Electric Light Commissioners for retaining Dr. J. T. Leary in the position of Secretary to the Board, their objections being based on the fact that the Doctor is the proprietor of a drug store in Roxbury. While the objectors would seem to have the weight of argument in their favor —Section 1, Chapter 503 of the Acts of 1894, provides that "The members of the Board of Gas and Electric Light Commissioners, and the Clerk of said Board, shall not engage in any other business"—it is nevertheless true that Dr. Leary's possession of the Roxbury drug shop has in no sense interfered with his duties as Clerk of the Commission; further, he has performed such duties in the most thorough and commendable manner.

WE are in receipt of a good, clear specimen of the photographer's art depicting the three-lift holder in steel tank, completed some time ago by Messrs. R. D. Wood & Co. for the Philadelphia Bureau of Gas. The dimensions of this holder (which has given perfect satisfaction to the Bureau since it was put in use) are as follows: Tank, 162 ft. by 29 ft.; inner section, 155 ft. 6 ins. by 28 feet.; middle section, 157 ft. 6 ins. by 28 ft.; outer section, 159 ft. 6 ins. by 28 ft. Another pleasant reminder that Messrs. R. D. Wood & Co. are right up to the times in gas works construction is in the shape of a handsomely printed and sensibly compiled pamphlet showing many of their specialties.

JUDGE EWING, in Branch Two, Common Pleas Court, district of Pittsburgh, Pa., has filed an opinion, in the suit of the city of Allegheny against the Peoples Natural Gas and Pipeage Company, in which the plaintiff's contention was upheld. The city sued for the sum of $5,386.45, claiming it under the ordinance which directs that all natural gas companies shall pay into the city treasury the sum of 3 cents per running foot on all main pipes laid by them through the streets.

THE following is from the Altoona (Pa.) *Mirror*, of date of August 31: "One of the busiest places in Altoona these days, and one at which the most notable improvements are being made, is at the plant of the Altoona Gas Company, in the Eighth Ward. The great majority of Altoona people, it may be presumed, know something of the Altoona gas works, but there are comparatively few who realize the rate at which they are growing, or the nature of the improvements being made, in order that the business of the Company may be more systematically conducted and its patrons better served. The erection of the present works on Seventh avenue and First street was started February 8, 1892. Hardly, however, had the undertaking been well completed than the rapid increase of business made the provision for still increased capacity a necessity, and early in the year 1893 the capitalization of the Company was doubled and an elaborate scheme of extension entered into. Among the most important of these extensions was the putting in of a duplicate set of apparatus for the manufacture of carbureted water gas, the combined capacity of which, after actual test, is twice that of all previous plants owned by the Company; and the product, when mixed with that from the coal gas plant, gives an illuminant to the consumer which is satisfactory in every respect. Beginning with this improvement still others of equal value have been added from time to time, and the work, as already stated, is yet in progress. There is now in course of erection, being well under way, a new gasholder of 1,000,000 cubic feet capacity. This is being built of steel throughout, and is of the most modern style of construction It rests in a steel tank, placed on a concrete bed, close to the surface of the ground. Its diameter is 165 feet 6 inches, and when fully inflated it will be one of the most prominent objects in Altoona's landscape. The holder is of the telescope order, having three sections. The weight of metals used in its construction will be approximately 2,200,000 pounds, and it is to be finished and ready for service by October of the present year. In connection with the holders on Green and Ninth avenues, the Company will then have storage room for 1,350,000 cubic feet of gas. The Company has a total of 72 retorts for the manufacture of coal gas, the capacity of these being 500,000 cubic feet every 24 hours. At present 30 of these retorts are being operated, turning out 210,000 cubic feet in 24 hours. The water gas plant above spoken of has a capacity of 1,000,000 cubic feet per diem, thus making the total capacity of the combined plant 1,500,000 cubic feet per day. The Company now has about 35 miles of main pipes throughout Altoona and Juniata, which suburb is also supplied with gas. Some of these mains are of large dimensions, the maximum diameter being 20 inches, and in all work of this character now being done calculation is made for the future growth of the city, with a consequently increased demand. At present the Company has a list of 3,685 consumers, and the number of meters set last year was 585. A new stable in Queen Anne style has lately been built at the works, extensive improvements are being made in all departments, and the grounds themselves will eventually present a picture of neatness which will go far toward making that portion of the city attractive to the eye. On the Seventh avenue side a neat and substantial iron fence has been erected, and in the rear a strong board fence incloses the grounds."

TWO weeks ago we printed the full text of the veto message written by Mayor Matthews, of Boston, in which that official refused to assent to an ordinance directing "that no main pipe for extending any existing gas main shall be laid in any street of the city of Boston unless authorized by an order of the Board of Aldermen." At a subsequent meeting of the Board of Aldermen the ordinance was passed over the veto, by a vote of eight to four. The reasons which impelled this action seem to have been summarized in the remarks of Alderman Hallstram, who said: "Pass this order over the Mayor's veto and let the rival Companies go to the courts and have the matter settled." Wherefore it would seem that the Board believes in making work for the lawyers.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

TERMS:
SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 Cents.

This is a recognized official organ of
LIGHT, HEAT, STEAM, WATER SUPPLY, VENTILATION, SANITARY IMPROVEMENT, AND GENERAL SCIENCE.

AGENTS:
New York—American News Co., 39 and 41 Chambers St.
Germany—B. Westermann & Co., of New York.

MONDAY, SEPTEMBER 17, 1894.

Phosphorescence.

At a recent meeting of the Chemical Society, at the Royal Institution, Professor Dewar gave an account of the researches he has lately been carrying out in connection with the behavior of substances exposed to light at a temperature of 180° below zero. In the course of these he found that the apparatus with which he was working was phosphorescing brightly; and he was thus induced to study phosphorescence itself at low temperatures. Naturally the question presented itself of the relation of phosphorescence to structure. The Professor therefore experimented with various definite organic compounds. A hydrocarbon like paraffine was feebly phosphorescent at ordinary temperatures; at low ones, it was brilliantly so. Many of the complex compounds known as ketones were exceedingly luminous—acetophenone, for instance. One of the most beautiful phosphorescing bodies was the complex salt the platinocyanide of ammonium, which shone with a splendid green light. Professor Dewar's experiments led him to the general conclusion that the more complex a body is in structure, the more likely is it to phosphoresce, perhaps because, in some way, its structure enables it to take up the light vibrations with more facility. The capability of oxygen for phosphorescing is another very curious fact. In the gaseous state, it can be made to glow if exposed to an electric spark while rushing into a large vacuum tube. This property is shared by its compounds, but is not possessed by hydrogen or any other gas.

The Market for Gas Securities.

No changes of moment in the prices of city gas shares are reported for the week, Consolidated being quoted at the opening to-day (Friday) at 123½ bid, offered at 124. One of the developments was a suspicious looking rise in the "securities" of the New York and East River Company, the brokers all seeming to agree that 21¼ was offered for the common. Mutual is steady, and the same can be said about Equitable and Standard preferred. There is no change in the Brooklyn situation, although it looks to us that all the parties in interest are coming pretty close to the agreeing point.

The bid prices of all Brooklyn shares show an increase for the week. Chicago gas is weak and lower, on rumors that a war of rates is imminent, but our belief is that the shares are cheap at the figures of this morning—72¼ to 72½. Baltimore Consolidated is steady at 67½. Laclede common remains at the quotation of last week. It was rumored in Wilmington, Del., this week, that the Bay State Gas Company, of Delaware, was to be placed in the hands of a receiver, but the Boston end of the concern asserts that there is no truth whatever in the assertion.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.
16 WALL ST., NEW YORK CITY.
SEPTEMBER 17.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	123½	124
Central	500,000	50	103	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	165	—
" Bonds	1,000,000	—	106	108
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	145	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	25	30
Preferred	5,000,000	100	80	—
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	105	—
Citizens	1,200,000	20	—	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	133	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	75	—
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	145	—
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	155	165
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	150	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	21	21¼
Income Bonds	2,000,000	1000	60	—
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	80	83
2d " " "	3,000,000	1000	59	—
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	160	—
Chicago Gas Company.	25,000,000	100	72¼	72½
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	56	60
Bonds	600,000	1000	92	—
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			90	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	—	67½
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
Con. Bonds			—	50
East River Gas Co., Long Island City	1,000,000	100	16	19
Preferred			25	35
Bonds	500,000	100	80	82
Equitable Gas & Fuel Co, Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	19	19¼
Preferred "	2,500,000	100	73	75
Bonds	9,034,400	1000	88½	88¾
Little Falls N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
New Haven, Conn		25	200	—
Oakland, Cal			42⅜	43
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Peoples, Jersey City	500,000	—	175	185
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	71	71½
Washington, D. C	2,000,000	20	240	—
Wilmington, Del.	500,000	50	188	190

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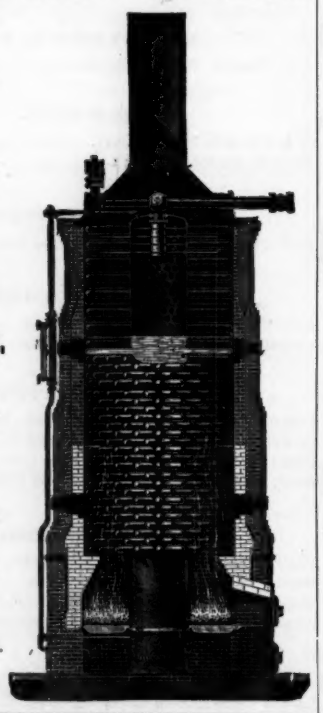

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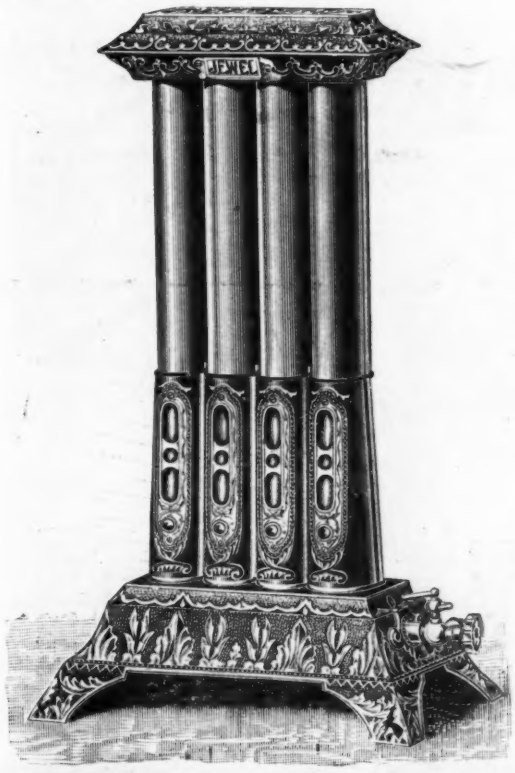

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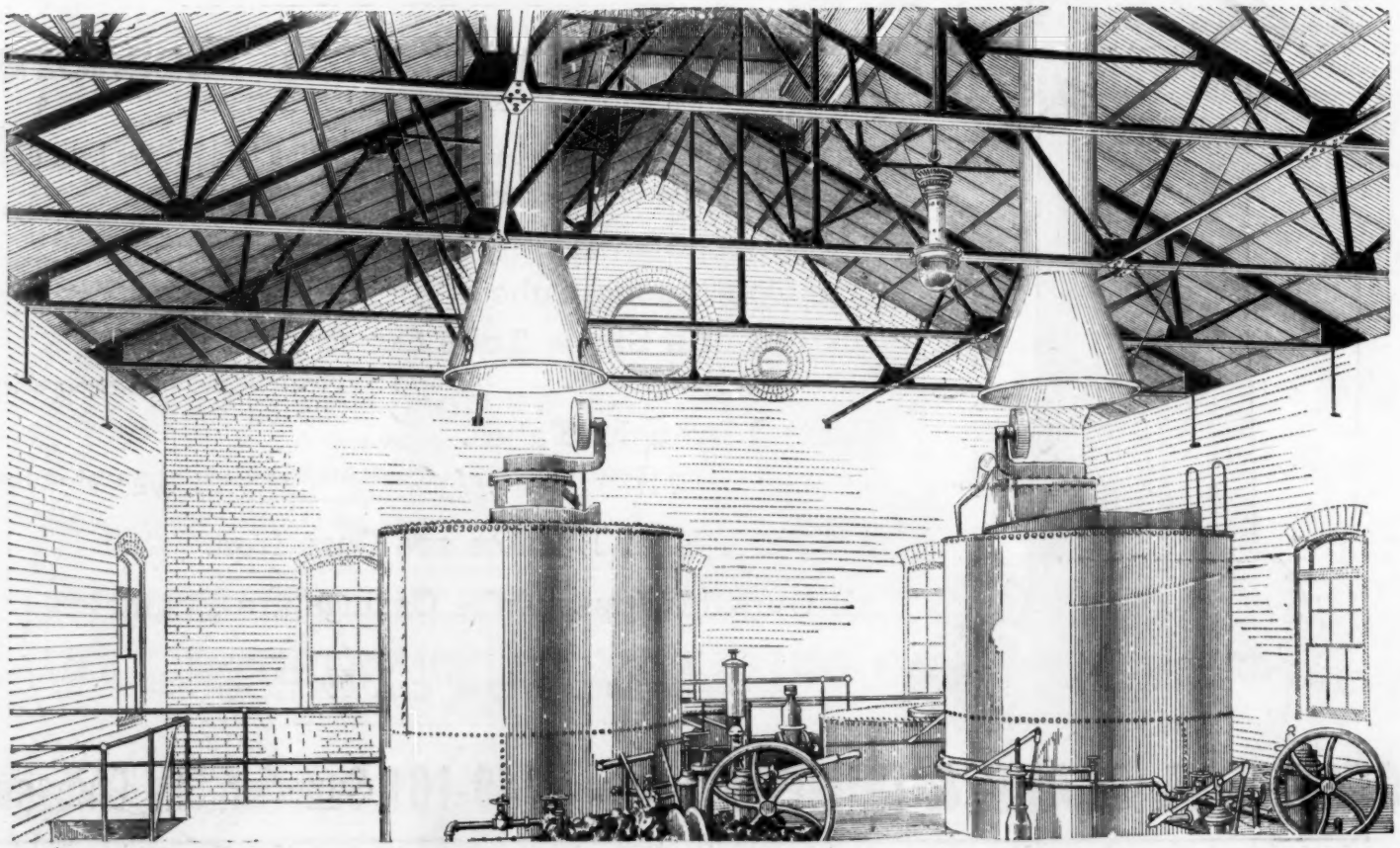

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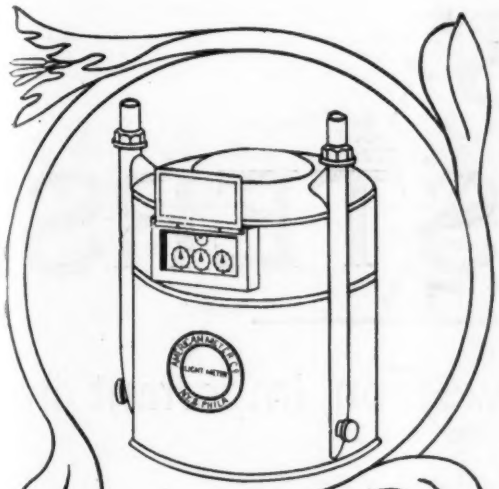

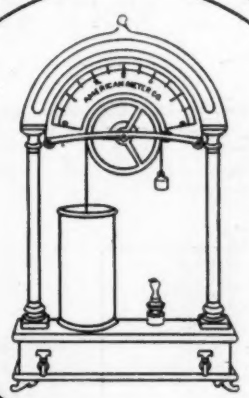

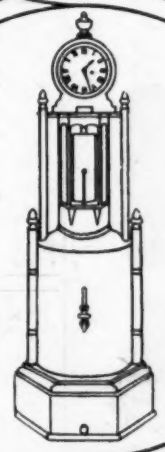

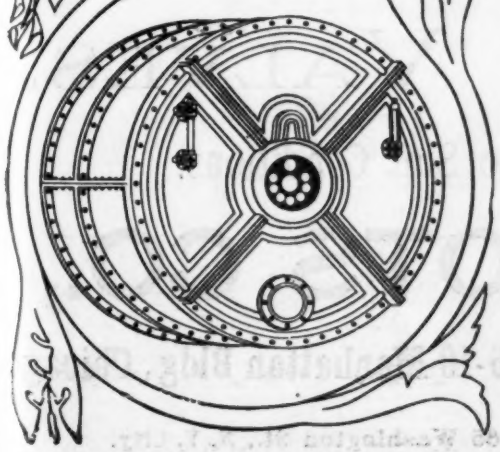

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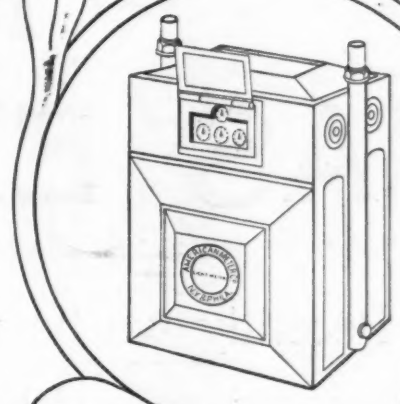
PUBLIC LIGHTING TABLE.

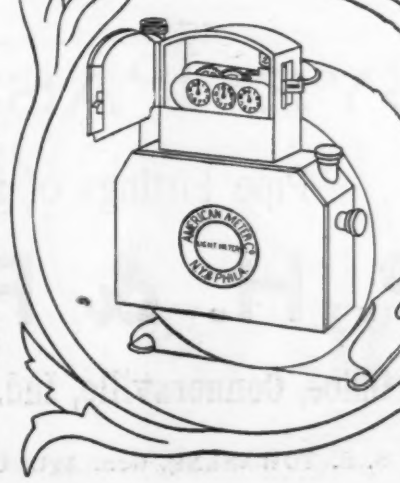
OCTOBER, 1894.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Mon.	1	6.10 PM	5.00 AM	5.30	5.00
Tue.	2	6.10	5.00	5.30	5.00
Wed.	3	6.10	5.00	5.30	5.00
Thu.	4	7.40	5.00	5.30	5.00
Fri.	5	8.40	5.00	5.30	5.00
Sat.	6	9.30 FQ	5.00	5.30	5.00
Sun.	7	10.30	5.00	5.30	5.00
Mon.	8	11.40	5.00	5.20	5.10
Tue.	9	12.40 AM	5.00	5.20	5.10
Wed.	10	1.40	5.10	5.20	5.10
Thu.	11	2.50	5.10	5.20	5.10
Fri.	12	3.50	5.10	5.20	5.10
Sat.	13	No L.	No L.	5.20	5.10
Sun.	14	No L. FM	No L.	5.20	5.10
Mon.	15	No L.	No L.	5.10	5.20
Tue.	16	5.50 PM	7.10 PM	5.10	5.20
Wed.	17	5.50	7.50	5.10	5.20
Thu.	18	5.50	8.40	5.10	5.20
Fri.	19	5.40	9.40	5.10	5.20
Sat.	20	5.40	10.40	5.10	5.20
Sun.	21	5.40 LQ	12.00	5.10	5.20
Mon.	22	5.40	1.20 AM	5.00	5.30
Tue.	23	5.40	2.30	5.00	5.30
Wed.	24	5.40	3.40	5.00	5.30
Thu.	25	5.40	5.20	5.00	5.30
Fri.	26	5.30	5.20	5.00	5.30
Sat.	27	5.30	5.20	5.00	5.30
Sun.	28	5.30 NM	5.30	5.00	5.30
Mon.	29	5.30	5.30	4.45	5.35
Tue.	30	5.30	5.30	4.45	5.35
Wed.	31	5.30	5.30	4.45	5.35

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Totai	2274.20	Total	3987.45





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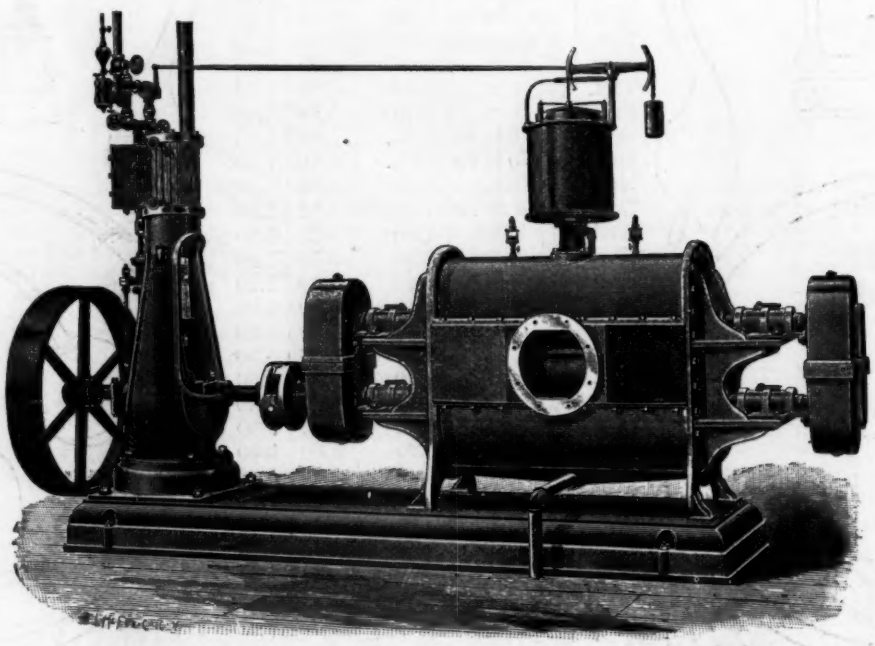

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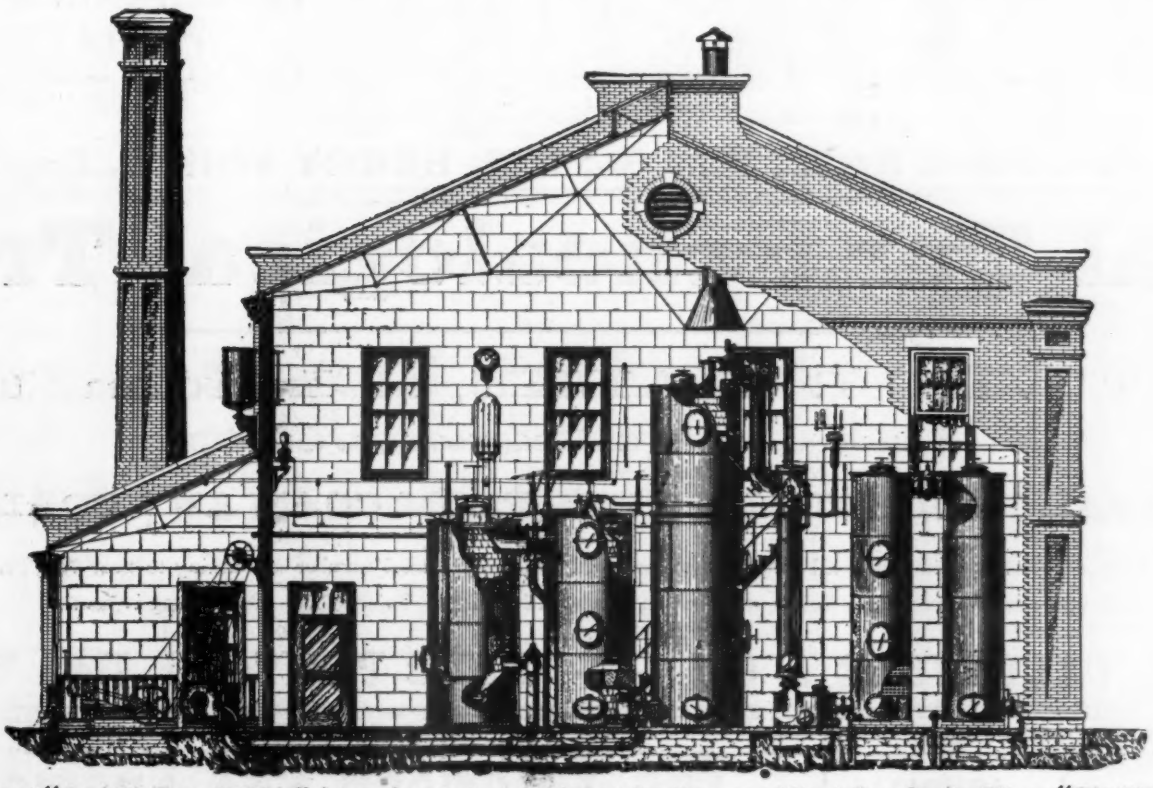

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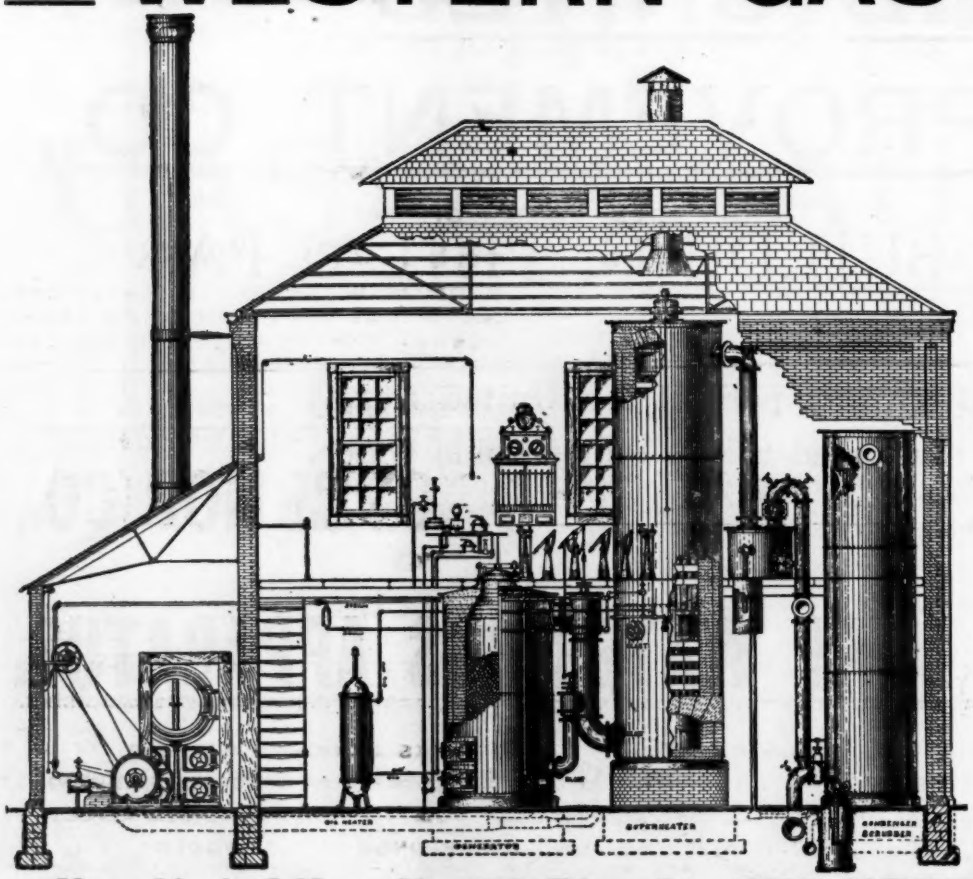

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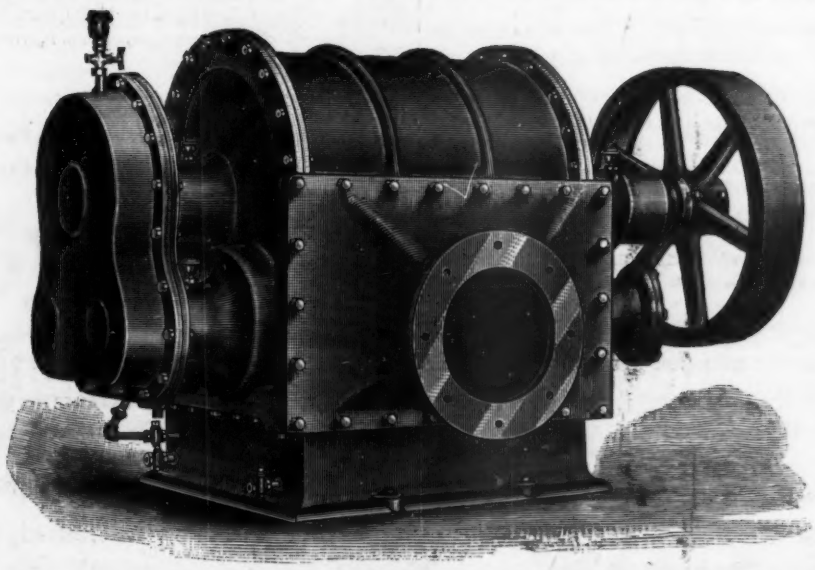

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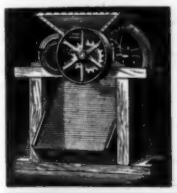

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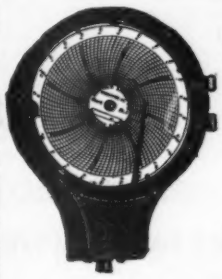

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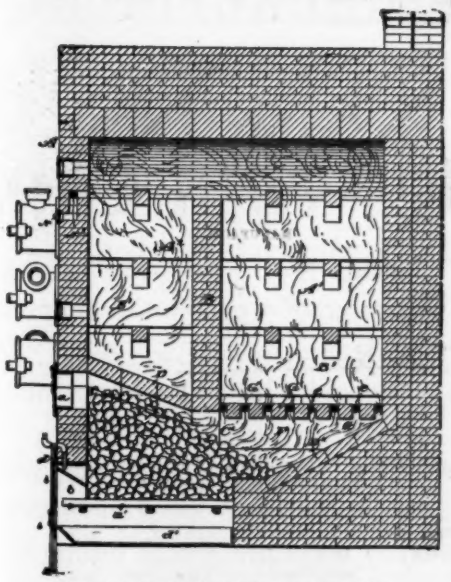

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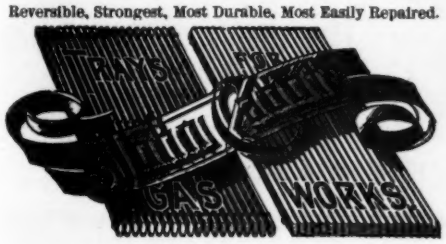

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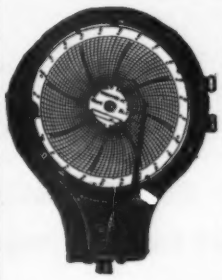

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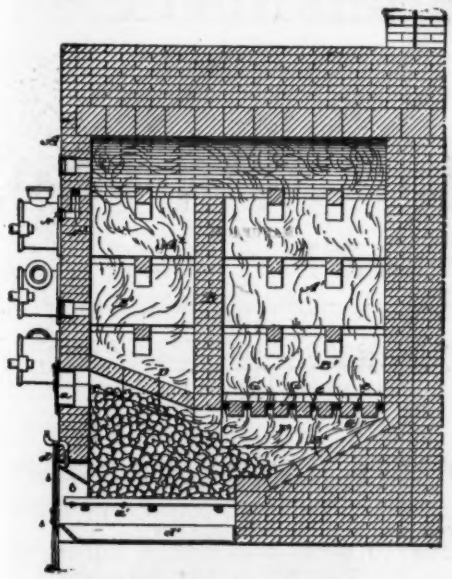

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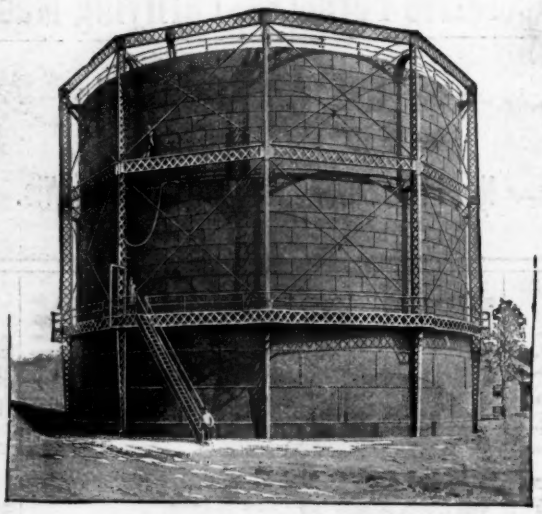

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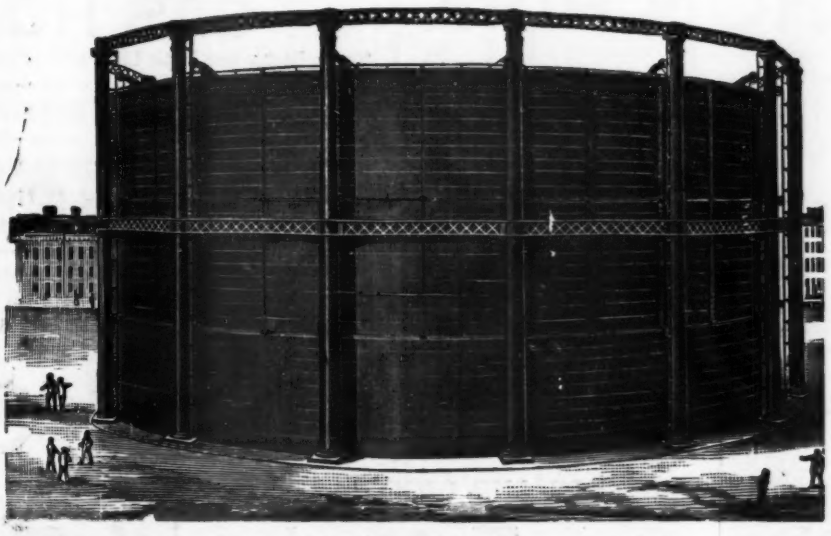

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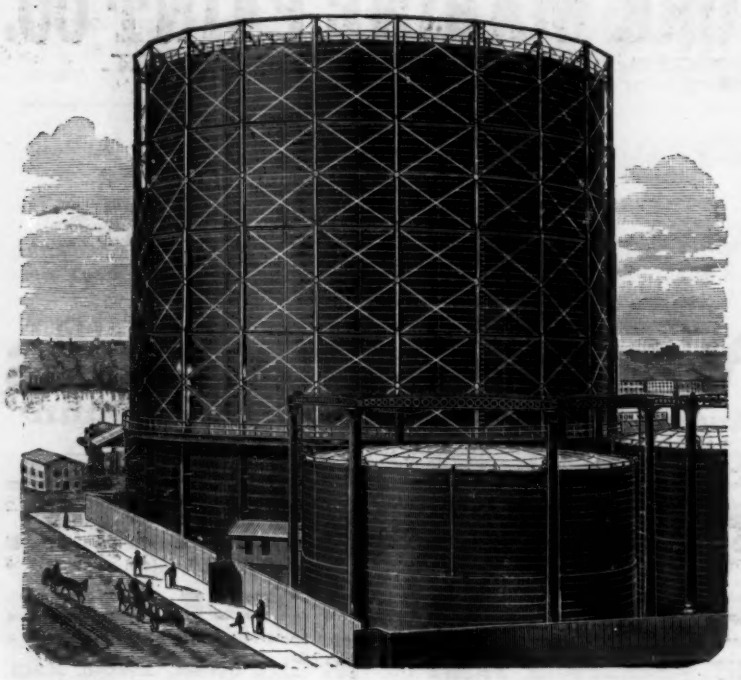

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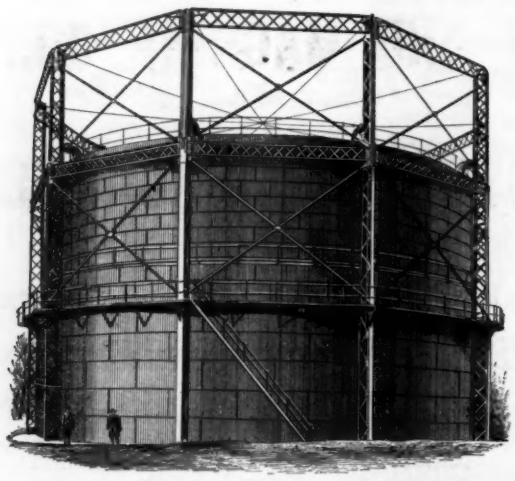

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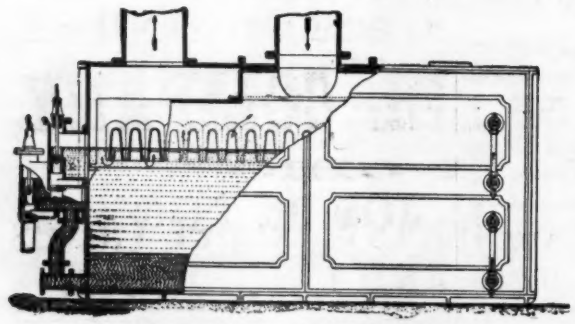

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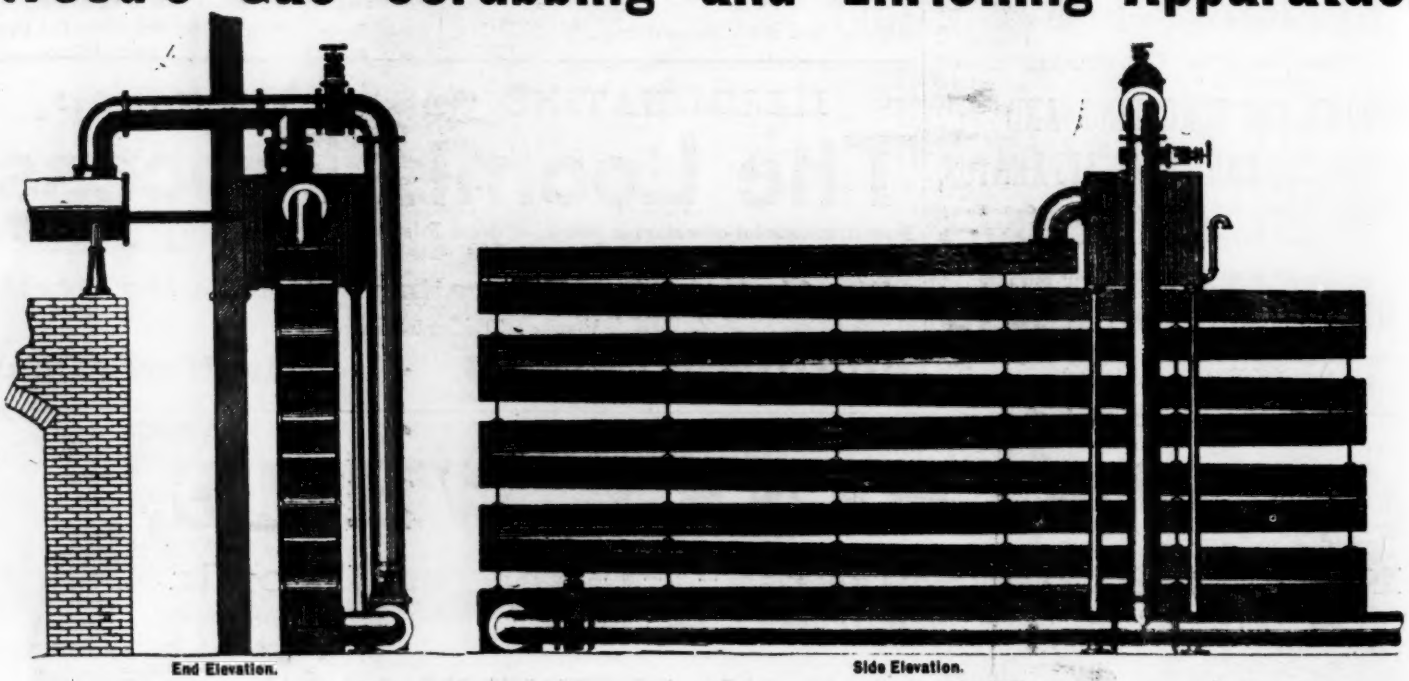

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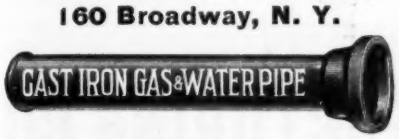

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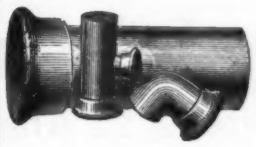

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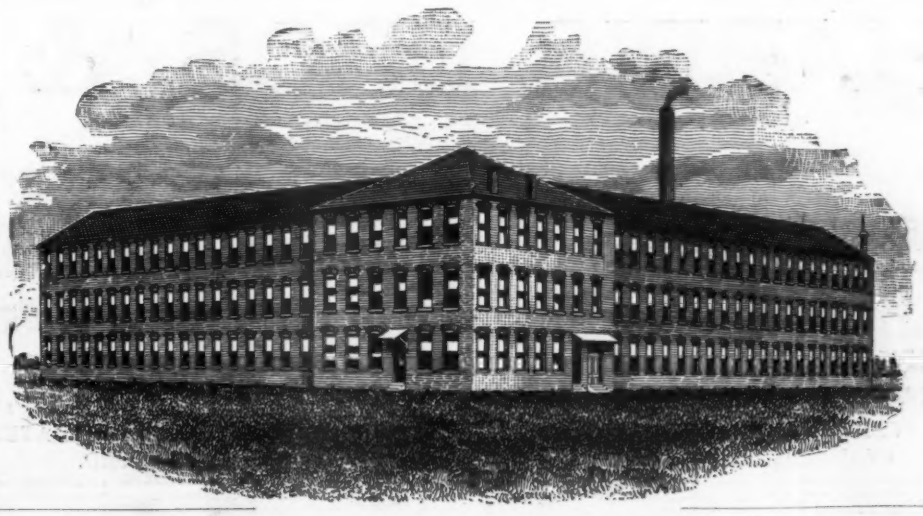

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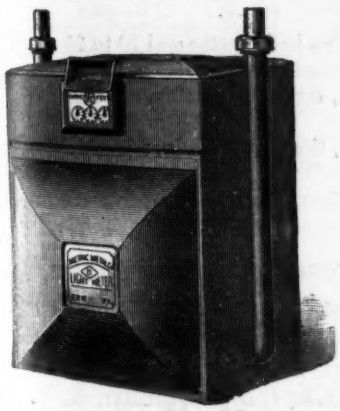

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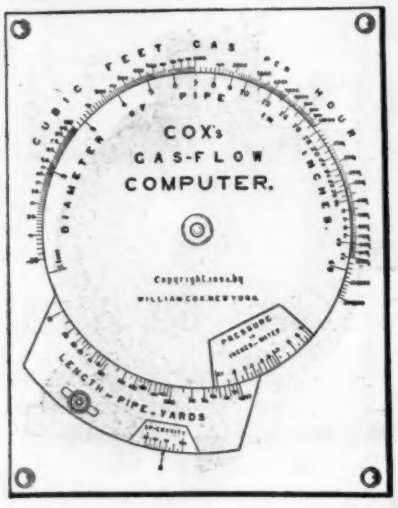

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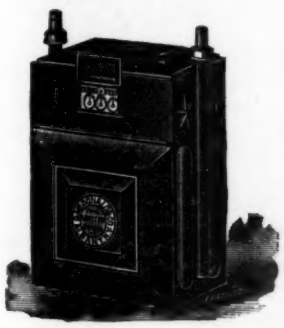

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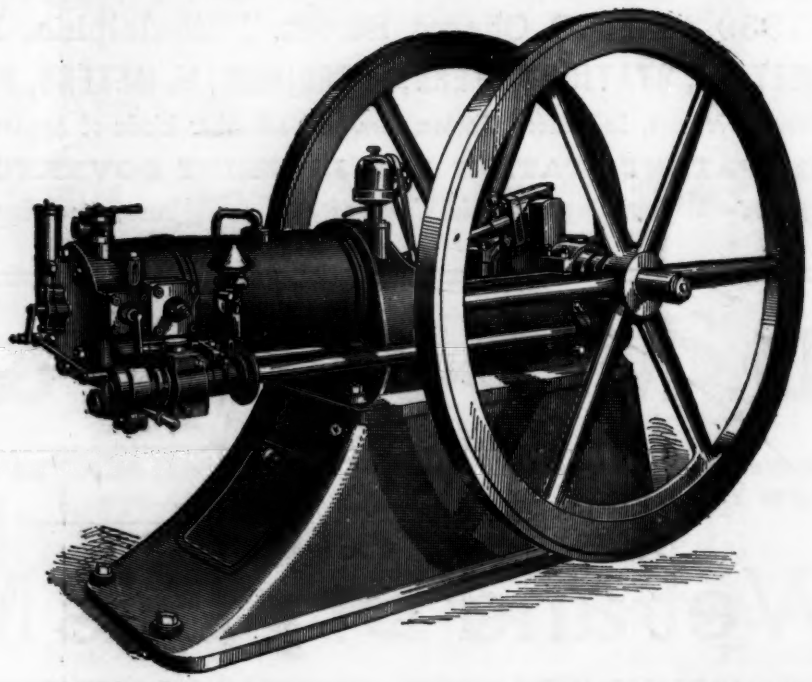

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